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ABSTRACT

The goal of the CAUSE conference was to provide a wide variety of presentations emphasizing the expanded role and the need for higher education management to more effectively use information systems. All higher education institutions are addressed: small colleges, community colleges, large universities, and state higher education agencies. Major areas considered are: management and information systems; development of information systems; use of information systems; and small college information systems. Among the topics covered in the 67 papers are: enrollment decline and institution size; financing systems in public institutions; system design; privacy and data processing; programmer job descriptions; security; software purchasing; data needs assessment; load-leveling and student work in financial aid; course registration; budgeting and financial management; computing centers in small colleges; personnel records and systems; planning models; interactive systems; a faculty information system; and student information systems. Brief vendor presentations are included among the papers. (MSE)

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Development, Use And Management Of Information Systems In Higher Education

Proceedings of the
1978 CAUSE National Conference

December 1978
New Orleans, Louisiana

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Edited by
Michael E. Schouest
and
Charles R. Thomas

HE 011 330

CAUSE

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INTRODUCTION

The CAUSE National Conference provides an excellent forum for the exchange of ideas, systems, and experiences among the many participants and speakers. The CAUSE '78 program theme focused on CAUSE's new expanded role: "The Development, Use and Management of Information Systems in Higher Education".

The goal of the Program Committee was to provide a wide variety of presentations emphasizing this expanded role and the need for higher education management to more effectively utilize information systems. The two keynote speakers and over fifty professional presentations addressed the theme and its applicability to harnessing information systems technology to more effectively support the management processes in higher education.

A wide range of speakers and concurrent track presentations addressed the entire CAUSE community...small colleges, community colleges, large universities and state higher education agencies. The Conference also addressed the many levels of information systems management and the concerns of users of information systems.

We hope these Proceedings will provide a continuing reference to the many activities of the Conference and the CAUSE organization. We also hope you will benefit from sharing the experiences of others and thus become more effective in the development, use and management of information systems at your institution.

We encourage you to utilize CAUSE to compliment your individual efforts at strengthening your organization's management capabilities through improved information systems.

CAUSE

CAUSE, the Professional Association for Development, Use, and Management of Information Systems in Higher Education, helps member institutions strengthen their management capabilities through improved information systems.

Formerly known as the College and University Systems Exchange, CAUSE first organized as a volunteer association in 1962 and incorporated in 1971 with 25 charter institutions. That same year the CAUSE National Office opened in Boulder, Colorado with a professional staff to serve the membership. Today the organization has grown to 280 member institutions with 1,000 member representatives and continues to grow at the rate of 10% a year.

CAUSE provides member institutions with many services to increase the effectiveness of their administrative information systems. These services include: the Exchange Library, which is a clearinghouse for non-proprietary information systems contributed by members; an Information Request Service to locate specific systems or information; consulting services to review ADP organizations and management plans; organizational publications including a bi-monthly professional magazine; and the National Conference.

The CAUSE National Conference provides an excellent forum for the exchange of ideas, systems, and experiences among the many speakers and participants. The proceedings provide a continuing reference to the many activities of the Conference.

Michael E. Schouest
1978 Conference
Chairperson

Robert R. Caster
1978 Conference
Co-Chairperson

Charles R. Thomas
Executive Director
CAUSE

ACKNOWLEDGEMENTS

The success of the CAUSE National Conference is due entirely to the contributions of people and supporting organizations. Although it would be impossible to identify all of the people who contributed time and effort to the planning and operation of the 1978 Conference, several deserve special note.

The Program Committee, with the CAUSE Staff, spent many hours to produce an effective and smoothly run conference. Their enthusiasm, efforts and the support of their institutions are gratefully acknowledged.

1978 CAUSE NATIONAL CONFERENCE PROGRAM COMMITTEE

Seated from left to right: Paul J. Plourde, SUNY/Potsdam; Robert R. Caster, University of Cincinnati; Patricia C. Skarulis, Princeton University; Michael E. Schouest, Louisiana State Department of Education. Standing from left to right: James S. Martin, University of Colorado; Bartley J. Carlson, College of Dupage; L. Carvel Whiting, University of Utah; Charles H. Naginey, Pennsylvania State University.

The logistics of conference registration were efficiently supervised by Mrs. Patricia Angerer of the CAUSE Staff with the assistance of Ms. Cindy Barry of Louisiana State University, Mrs. Rosemary N. Menard and Mrs. Sandra Sanchez of the Louisiana State Department of Education. Their efforts and friendly smiles are appreciated.

The advance preparation for the Conference and the publication of the proceedings require a great deal of professional expertise and effort. The contributions of Mrs. Patricia Angerer, Mr. Robert Byrd and Mrs. Debbie Smith of the CAUSE Staff are sincerely appreciated.

The continuing support of the CAUSE Board of Directors and the membership they represent is also gratefully acknowledged.

1978 CAUSE BOARD OF DIRECTORS

Seated from left to right: Richard L. Mann, University of Kansas; John W. Gwynn, University of Wyoming; R. Brian Walsh, University of Notre Dame; Robert R. Caster, University of Cincinnati. Standing from left to right: Bard R. White, Amherst College; Joseph A. Catrambone, University of Illinois; Vinod Chachra, Virginia Polytechnic Institute and State University; William Mack Usher, Oklahoma State University. (Not present for this picture: Maureen Murphy, University of Oklahoma.)

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GENERAL SESSION

WEDNESDAY KEYNOTE ADDRESS

Constants of Change

F. G. "Buck" Rodgers
Vice President
Marketing
IBM Corporation
Armonk, New York

In addressing the topic "Constants of Change", Mr. Rodgers discussed many of the human factors that must be dealt with in an age of rapid technological change. Mr. Rodgers made several points to illustrate the importance of these human factors:

> In the next five years the price performance of computer equipment will increase by 600% while there will only be a 30% increase in the number of systems people.
>
> Currently each production worker averages about $40,000 worth of equipment, while each office worker averages about $10,000 worth of equipment, making paperwork one of our greatest areas of hidden cost.
>
> By 1982 one-half of the workers in the United States will be white collar workers, and 50% of the cost of doing business will be in paperwork.

Mr. Rodgers pointed out that the job for management is to use data as a resource to "find problems before they become disasters".

He emphasized that the "Constants of Change" are things that do not change. Success or failure of a venture ultimately depends a great deal on how people are treated. The successful manager maintains respect for the individual, creates a desire to serve, and expects excellence.

GENERAL SESSION

WEDNESDAY LUNCHEON ADDRESS

Jules A. d'Hemecourt IV
Professional Journalist & Humorist

A CAJUN CHRISTMAS

GENERAL SESSION

THURSDAY KEYNOTE ADDRESS

THE CHALLENGES OF INSTITUTIONAL MANAGEMENT AND INFORMATION SYSTEMS

Nolen M. Ellison
Chancellor
Cuyahoga Community College

In addressing his keynote topic, Dr. Ellison outlined several areas of challenge for the chief executive of a college or university. The key challenge areas are:

Strategic Planning: Dr. Ellison emphasized that "there is no choice but to plan". He indicated that most executive boards spend much time on operational plans and little time on strategic planning.

Human Resource Development. Dr. Ellison indicated the role of the chief executive in this area is to create a "climate of readiness" for information systems by preparing people. He cautioned that an environment should not be threatened beyond that environment's ability to respond.

Managing Fiscal Resources. Dr. Ellison recommended the development of sound annual planning and budgeting systems tied to long-range planning.

Managing the Processes of Change. Dr. Ellison discussed various ways to meet this challenge, including the use of new processes like matrix management. He cautioned that the application of any systematic process is "hard work" and emphasized that the human factors are paramount in the process.

Dr. Ellison quoted Dr. Harlan Cleveland, who said : "If the Chief Executive doesn't know where he or she is going, then information systems cannot be effective".

Dr. Ellison advised the designers of information systems to "Keep it Simple". He also emphasized the importance of not re-inventing the wheel for every new system.

GENERAL SESSION

John Gwynn presents a gift of appreciation to CAUSE 78 Chairperson Michael Schouest while Board member Dick Mann looks on.

Contributed Papers Coordinator Jim Martin receives his gift from Chairperson Michael Schouest.

Outgoing CAUSE President John Gwynn (right) presents the gavel to newly-elected President Vinod Chachra.

THURSDAY LUNCHEON

Program Chairperson Michael Schouest presented tokens of appreciation to the members of the Program Committee and the Registration Staff. CAUSE President John Gwynn introduced the new members of the Board of Directors and the new officers. Retiring Board members were awarded Certificates of Appreciation.

Vinod Chachra's first task as new CAUSE President is to present outgoing President John Gwynn with a Certificate of Appreciation.

Editorial Committee members at the Thursday luncheon (from left) Jan Fretwell, Mary Jo Mangan, Jerry Magnuson, Wayne Ostendorf. (Attending but not pictured: Jim Strom and Betty Keena.)

VENDOR PARTICIPATION

Participation of the following companies in the 1978 CAUSE National Conference is greatly appreciated.

Arthur D. Little, Inc.
Harris Computer Systems Corporation
Honeywell Information Systems, Inc.
International Business Machines Corporation
Informatics, Inc.
Information Associates, Inc.
Integral Systems, Inc.
Itel Corporation
Management Science America
MSL/Campus
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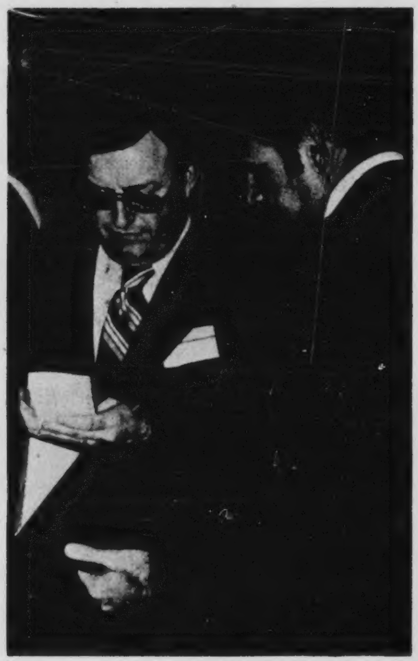
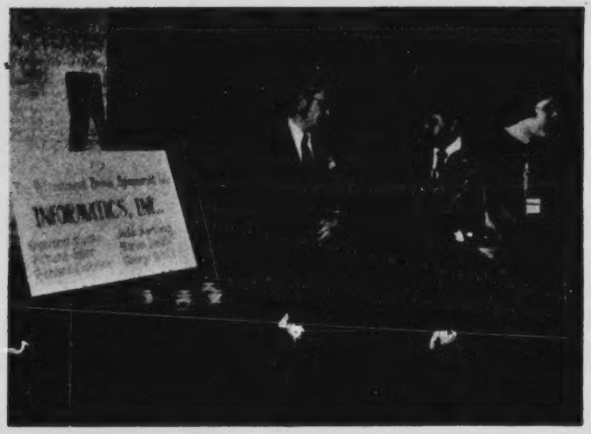



INFORMATICS, INC.

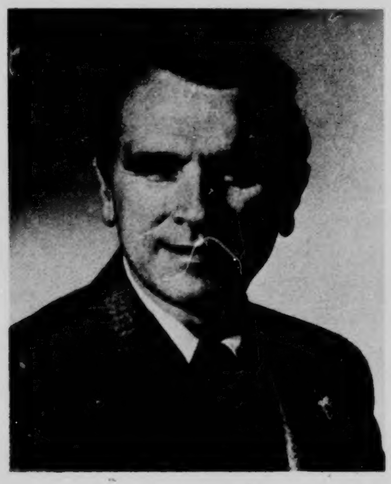
REGISTRATION RECEPTION

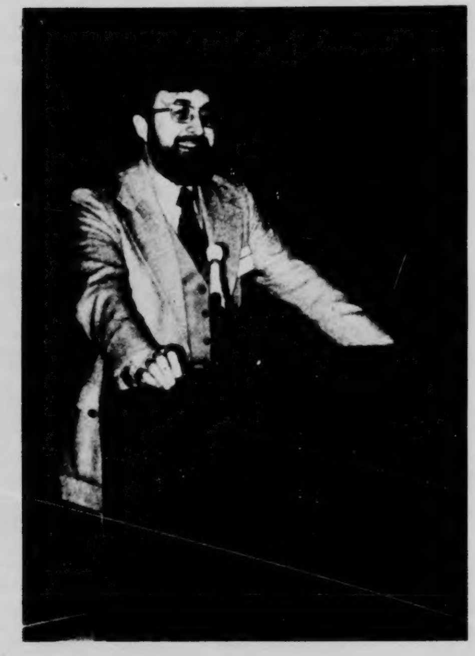
TUESDAY EVENING, DECEMBER 12

TRACK I

MANAGEMENT AND INFORMATION SYSTEMS

Coordinator:
Charles H. Naginey
Pennsylvania State University





Robert G. Arns
The University of Vermont

William R. Turner, III
Cornell University

ENROLLMENT DECLINE AND INSTITUTIONAL SIZE: USING MANAGEMENT INFORMATION TO ASK THE RIGHT QUESTIONS

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Presented at:

1978 CAUSE National Conference
New Orleans, Louisiana

December 13, 1978

ENROLLMENT DECLINE AND INSTITUTIONAL SIZE: USING MANAGEMENT INFORMATION TO ASK THE RIGHT QUESTIONS

ABSTRACT

This paper argues that one of the key determinants of MIS effectiveness is the appropriateness of the questions posed by managers. Three types of situations faced by institutional executive managers are delineated: situations that can be directly influenced by management actions; situations that can only be indirectly influenced by management actions; and situations that are essentially beyond the influence of management actions. The nature and form of useful management information differs markedly from one type of situation to another. The issue of managing institutional size and program mix is used to illustrate these general ideas. When questions concerning demographic trends and enrollment declines are paramount in manager's minds one set of needs for management information emerge. On the other hand, if the issue is seen in terms of establishing and maintaining optimal institutional size, a very different pattern emerges. Information needs focus much more on management questions such as alternative sizing possibilities, size and program mix trends over time, and measures of institutional closeness to optimal size. The latter perspective is seen as distinctly preferable in that it enhances the likelihood that the information produced by the MIS will pertain to situations that can be directly or indirectly influenced by management actions.

ENROLLMENT DECLINE AND INSTITUTIONAL SIZE: USING MANAGEMENT INFORMATION TO ASK THE RIGHT QUESTIONS

Introduction

We wish to propose as a basic premise that the appropriateness of the questions posed by institutional managers chiefly determines the effectiveness of institutional management information systems. The more clearly a manager can articulate what he or she really needs to know - and why - the more likely it is that a management information system (MIS) can be designed to respond to that manager's perceived information needs. This general premise will be illustrated through detailed consideration of a significant problem facing many institutions today; namely, institutional response to current and prospective student enrollment declines.

From a managerial point of view, the real issue consists of appropriately managing institutional size and program mix. When questions concerning demographic trends and enrollment declines reign in the manager's mind, one set of management information needs emerge. However, if the issues emerge in terms of establishing and maintaining optimal institutional size, a very different pattern results. Information needs focus more on management questions such as alternative sizing possibilities, size and program mix trends over time, and measures of institutional closeness to optimal size. We believe this latter perspective to be distinctly preferable for institutional managers and those engaged in developing useful management information systems, especially since it enhances the likelihood that the MIS will produce information relevant to situations that can be directly or indirectly influenced by management action.

The notion of managerial influence upon possible events seems pivotal in this context. Specifically, we recognize three different kinds of situations that confront the institution and its management. First, the manager confronts those future events which may potentially impact the institution, but which cannot be controlled or even directly influenced. Here the emphasis must be on accurate and timely knowledge of such events and on the development of a capacity to adapt to these events as they occur. The ability to predict trends and events to which the institution must respond becomes a matter of paramount importance. As one management expert has noted: "The art of effective planning is to recognize the inevitable and take credit for it." With respect to enrollment patterns and institutional sizing issues, relevant factors that the institution requires information about and yet cannot control include: overall demographic trends, trends and decisions within various age groups concerning college attendance, absolute numbers of those deciding to attend college, and the quality and preparedness of the prospective student population.

A second category of factors confronting the educational manager consists of those events which the institution may influence but cannot directly control. These include matters of federal, state, or local public policy as they regard institutions of higher education, both public and private. These public policies involve a broad spectrum of issues including student aid, institutional support, affirmative action requirements, and a wide range of other issues. The institution can also exert influence upon its reputation in the community and among prospective students but cannot directly manage or control that reputation. Similarly, the institution may exert some influence among prospective students with regard to their choice of college but cannot control that choice to any substantial extent. From an information management point of view, the institution meet develop a sense of the areas in which it wishes to exert its influence and to identify the kinds of management information that would be useful given this set of priorities. In the enrollment and institutional size arena, such information might include data on career trends and choices among prospective students, information on federal or other governmental bodies' attitudes and trends with respect to financial aid for students and other issues, and perhaps even information on the strengths and weaknesses of the institution as perceived by prospective students and other constituents.

The third category of events, perhaps the most important from our perspective here, consists of those which can be directly controlled or managed by the institution. Here the key issue involves deciding what particular elements of the institution can be managed, how and by whom they will be managed, what interdependencies exist among the various elements of the college, and what information is most needed by the various institutional managers and the units for which they are responsible. We propose to discuss and illustrate how institutional managers can respond to the problem of "enrollment decline". Among events that managers can control and influence, we focus on the question of institutional size and the determination of an optimal institutional size within constraints of efficiency, effectiveness, and flexibility. The kinds of management information that can be helpful in making this determination of appropriate institutional size will be illustrated throughout.

Statement of the Problem

The issue of finding an appropriate match between institutional capacity and educational demand has been a management concern in one form or another for several decades. As recently as the early 1970's, that issue was posed primarily in terms of finding higher education capacity to meet the ever increasing demand for educational opportunity. Relatively recently, that framing of the question became suddenly irrelevant because the era of expansion and unlimited growth ceased. Institutions face an entirely different situation, captured succinctly in a recent Chronicle of Higher Education headline: "The Enrollment Roller Coaster: Colleges Fear the Big Dip." The new statement of the size issue confronting institutions and their management has been popularly cast in terms of how to deal with an era of no growth or even absolute decline. Student enrollment [illegible] crises, issues of institutional survival, and similar problems seem to define the context for institutional management during the coming era.

We propose that the persistent issue facing institutional managers whether during periods of growth, stasis, or decline is the question of size determination. Regardless of the level of demand, the managerial task consists of fitting institutional capacity to that demand. Furthermore, institutional managers can directly control institutional size and thus size determination becomes a viable focus for management action and the development of supporting management information systems.

In the past, the tendency has been to define the managerial problem as one of managing growth. This attitude has given rise to many serious limitations in an era of leveling out or decline. Many techniques learned in managing growth do not directly relate to managing a situation of institutional shrinkage or decline. Enrollment driven funding formulas that worked well during an era of increasing enrollments well illustrate that prior technologies come up wanting during a period of shrinkage. The Ohio Board of Regents for example, has contracted with management consultants to devise a budget formula that will work during a period of declining enrollment. A Board spokesman recently noted that the existing formula, which ties state support to numbers of students, worked well while enrollments were rising, but may not work so well when enrollments are dropping. (Chronicle of Higher Education, Sept. 5, 1978).

In other words, it appears short sighted to view the issue simply as one of managing growth or managing decline. If the problem is seen as one of managing institutional size instead of either growth or decline, it becomes possible to develop models, skills, insights, and management information systems which are potentially suited to periods of growth, stasis, and decline. In an ideal sense, a management attitude of this sort might permit higher education to operate well (by which we mean, effectively and efficiently) at a variety of different volumes. Just as the automobile industry can comtemplate operating a 12 million model year or an 8 million model year without any particular panic, it may be possible to learn to manage higher education at widely different volumes of student enrollment without disasterous effects. This is not to say, of course, that there can be a one-to-one transfer of industrial management techniques to the higher educational sector. We mean simply that the breadth of definition of the question managers ask may be a key to truly effective institutional management and the development of supporting management information systems.

If management focuses on this question of institutional size, it must identify the variables, goals, and constraints which relate centrally to this pursuit. Two critical areas of goals and constraints seem to be encompassed under the heading of concerns of efficiency and effectiveness.

Efficiency is a shorthand description of management's intention to provide the largest quantity of educational product with the lowest expenditure of institutional resources. In the profit sector, dollar efficiencies can be translated into additions to the bottom line profit of the corporation. In the not-for-profit sector, including higher education, the issue becomes more complex. Cost savings for the institution, the consumer, or some third party funding agent may motivate the manager. This efficiency motive may seek to invest efficiency savings in qualitative improvements in the institution or the educational process. Obviously, even the not-for-profit institution must find sufficient efficiency to avoid suicidal financial losses.

The institutional manager needs to be concerned not only with how efficiently the institution operates, but also with how well the consumers receive the various products of the institution or how effectively the institution operates. In higher education, much work focuses on the development of outcome measures and related techniques. Most of this work recognizes, appropriately enough, that actual outcomes are at best indirectly influenced by institutional management. Nevertheless, this indirect influence may be important form a managerial point of view. The notion that the consumer will be concerned about the quality of the goods and the services to be obtained from a particular institution and that this may well impact upon institutional choice has an obvious connection to the overall issue of institutional sizing in the face of variable student demand. Questions of efficiency and effectiveness are both integral to the management of institutional size. From an operational point of view, the key question is how these dual concerns can be related to institutional size through the use of management information.

Defining Institutional Size

When the issue of reacting to prospective enrollment declines is redefined in terms of the need to manage institutional size or volume, one encounters initially the problem of defining volume. Institutions of higher education are complex organizations and their capacities and outcomes encompass a wide spectrum of learning, development of new knowledge, and contributions to the community. Any comprehensive definition of institutional capacity would consider all these types of endeavors and outcomes. This exploratory paper will focus only on the issue of instructional size or volume for several reasons. First, instructional volume is a common denominator among all institutions of higher education. Further, and more pragmatically, student instruction may be readily quantified. Finally, the issue in question is most usually stated in terms of student enrollment declines and so the broadening of focus to the question of institutional sizing seems most appropriately to begin with student instruction. This is not to deny that other areas of institutional endeavor are extremely important or that the notions discussed here could potentially be extended to these other areas.

The outcomes of instructional activity are ultimately defined in terms of what happens to those who receive instruction at the institution. Such outcomes are primarily matters of long term concern and not under the direct or even indirect control of the typical institutional manager. Once again using the guideline of focusing on what can be influenced or controlled by institutional management, a variety of indirect measures of instructional volume and results suggest themselves. All of these are familiar: head count enrollment, full time equivalent students, student credit hours, student contact hours and other similar measures.

We opt here for a focus on student credit hours (SCH) as a measure of institutional size for a variety of reasons. Student credit hours provide a unit of measure which can be applied to all elements of the student body and to all of the instructional subunits of the institution. Graduate and undergraduate students, full time and part time students, and other subgroups can be measured comparably. Institutional subunit size and capacity can also be measured uniformly through attention to student hours generated. Since academic credits also represent services students buy from the institution, revenues and student credit hours will be closely correlated in most institutions.

Several cautionary notes concerning the use of student credit hours as a measure of institutional size are appropriate at this point. For one thing, the use of different measurement schemes may present different patterns. Table 1 shows opening undergraduate enrollment for one educational institution in terms of both student credit hours and head count enrollment. Both student credit hour data and head count enrollment data have been converted to index numbers with 1971-72 representing 100 on the index scales. The effect of using different variables to measure capacity or size is readily apparent. Using student credit hours as a measure of size over this time period indicates a slightly increasing size of the college while using full time undergraduate enrollment indicates a slight decrease in size. Of course, no single variable will ever be adequate to describe entities as complex as educational institutions. A great deal of caution should be applied and, if possible, the kinds of ideas illustrated here should be checked out using a variety of different indicator variables.

A second important caution is that measuring only the overall size of the institution may also be misleading. The five year picture given in Table 1 presents a picture of relative stability for this institution. Were the university a single purpose institution serving full time undergraduates, that growth measurement might be adequate. However, the information given in Table 2 shows the same five year pattern by college within the university. The differences in patterns from one college to another indicate the need to make finer measurements and also illustrate well the utility of using student credit hours as a measurement of subunits of the total institution. While the overall size of the college as measured by student credit hours has varied in only minor fashion over the five year pattern, this stability conceals internal variations among subunits of some considerable magnitude.

Through the use of a consistent, lowest common denominator unit of measurement such as student credit hours, analysis of institutional size become much more illuminating and reveals how the overall size of the institution reflects the sum of the sizes of various subunits. The subunit size may vary considerably within a stable institution size. Student credit hour measurement permits measurement by course, by instructor, by level, by discipline, by department, or by school, so that the size of the institution may be viewed in the very detailed way as the sum of its component parts.

	1971-72	1972-73	1973-74	1974-75	1975-76
Student Credit Hours	141,385	140,347	131,911	138,739	145,727
Index	100	99	93	98	103
Opening Full-time Head Count	3,673	3,472	3,343	3,447	3,460
Index	100	94	91	94	94

Table 1

SAMPLE INSTITUTIONAL SIZE INFORMATION

	1971-72	1972-73	1973-74	1974-75	1975-76
College of Business Administration	31,202	30,853	33,428	39,532	44,278
Index	100	99	107	127	142
College of Education	15,855	16,473	13,655	12,864	15,605
Index	100	104	86	81	98
College of Liberal Arts and Sciences	64,317	62,487	55,552	54,500	53,930
Index	100	97	86	85	84
University Total	141,385	140,347	131,911	138,739	145,727
Index	100	94	91	94	103

Table 2

STUDENT CREDIT HOUR TRENDS FOR
UNIVERSITY AND COMPONENT COLLEGES

Managing Institutional Size

Thus far we have focused on the importance of selecting the most appropriate management questions, identified the issue of institutional sizing (as opposed to reaction to enrollment declines) as an illustrative management issue, and selected student credit hours as an appropriate measure of institutional size. We now need to focus on how this set of constructs can be applied in practice. Specifically, we wish to highlight the kinds of management information that can be useful in applying the approach identified thus far.

The issue of managing institutional size can be viewed in terms of three interrelated goal areas: effectiveness, efficiency, and flexibility. Higher education is a service rather than a product oriented enterprise and so the issue of service effectiveness appropriately assumes paramount importance. Some will be immediately wary of managers who consider effectiveness or quality the primary management concern. This seems particularly true since academic quality appears elusive, open to wide ranging interpretation, and the domain of non-managerial academics. Nevertheless, some useful and quantifiable effectiveness measures seem available which adequately preserve traditional academic concerns. These suggest one operational way in which questions of academic quality can be integrated with the overall question of managing institutional size.

The measures we focus on here revolve around the student credit hour measurement discussed earlier. All of an institution's academic degree programs can be defined in terms of student credit hours (or some similar measure). These degree programs are subdivided into some set of courses which have varying numbers of student credit hours associated with them. These courses are typically provided by a major department and a variety of other supporting or service departments. The academic matrix notion developed by Suslow and latter refined by the National Center for Higher Education Management Systems in the form of the Instructional Work Load Matrix (IWLM) and Induced Course Load Matrix (ICLM) are structures that portray these course and program patterns. Information on courses required and/or actually consumed by students is available as a part on the management information system of virtually every institution. This listing of departmental courses and the patterns of consumption within academic degree programs consciously or unconsciously represents some notion of effectiveness for that department and its related majors. The mix of courses provided to various types of students and the frequency with which these courses are provided are proxies for the perceptions of the institution and the appropriate academic subunits as to what constitutes an effective program in a particular area. Variations in patterns of course offerings and/or course consumption over time could also be a useful proxy for perceptions of effectiveness in given academic programs.

However, questions of academic quality and effectiveness are not usually posed within the institutional context in terms of IWLM's and ICLM's but instead are seen in terms of departmental course offerings and professional staffing for those courses. For example, one may determine that a department responsible for supplying a discipline both for students majoring in that discipline and for non-majors needing that discipline to support their academic majors requires five full time faculty trained in five separate subdisciplines. One might also judge that providing that discipline with appropriate effectiveness requires the offering of 40 different courses during an academic year and that instructional quality will be optimized if class sizes average 25 students. Finally, one might determine that each faculty member should teach eight courses a year to maintain appropriate standards for preparation and instruction-related research.

Note that the example given presumes no normative judgements about the appropriate number of subdisciplines within the hypothetical discipline, no normative statement about average class size, nor about the number of courses each faculty might appropriately teach. All these quantities could be changed to fit the idiosyncrasies of institutions or even separate departments. Regardless of how the judgements change to fit different situations, the variables do yield quantifiable effectiveness standards which also define a base capacity for an academic department. Furthermore, these quantifiable variables may be derived from traditional discussions of instructional effectiveness or quality.

The example can serve to illustrate how qualitative judgements may be quantified. Suppose the five faculty were to have taught a total of 40 courses with an average class size of 25. Presuming that each student would earn three credit hours for each course, the base capacity of the department, expressed in terms of student credit hours (our preferred unit of measurement) would be 3000 student credit hours. The five full-time faculty members would represent, on the average, capacity for 600 student credit hours for each member. This could be represented graphically as in Figure 1.

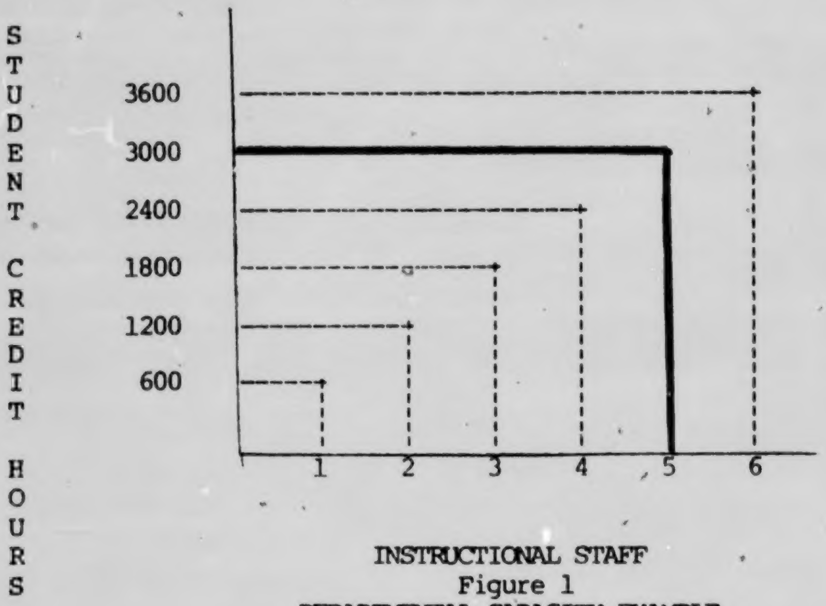

Figure 1
DEPARTMENTAL CAPACITY EXAMPLE

In this instance, the capacity of the department has been defined as 3000 student credit hours. Obviously, if other variables were held constant, a four subdiscipline department would have a capacity of 2400 student credit hours, a two subdiscipline department would have a capacity of 1200 student credit hours, and so on. Regardless of how these variables might be treated within the effectiveness constraints of individual institutions or departments, the manipulation of the variables can yield a quantifiable measure of capacity. An iterative process, working department by department within an institution, could define an effective capacity for each department. Having completed such a process one might then use the relatively complex ICLM's and IWLM's to determine how these departmental base-line capacities affect the base-line capacities of the entire institution.

One major benefit of using student credit hours as a proxy measure to incorporate a variety of judgements about effectiveness is the ability to link that quantified effectiveness capacity to another management goal; namely, institutional efficiency. The effectiveness judgements referred to above could define an ideal capacity for the institution. In other words, if all the capacities defined in all departments of the institution were actually consumed by students enrolled, the institution would be operating at maximum efficiency within boundaries of its effectiveness judgements. Conversely, if the real volume of student demand is somewhere less that this ideal volume or capacity, then the institution is operating at some level of inefficiency and must bear some corresponding inefficiency costs.

However, the institution's actual volume or size is not completely within the control of management. The number of student credit hours produced depends not only on what the institution can supply but also upon the demands students place upon the institution. This is true not only in terms of actual student enrollments but also in terms of individual student choice of majors and even of individual courses within majors. Thus managers confront an inherent twofold problem: the need to influence students to demand courses and programs that are in keeping with the college's capacity while fitting institutional capacities so that it can supply what students will demand in the most efficient manner possible.

Realistically, the actual volume of the institution and its subunits will probably never equal the "ideal volume". From a management point of view it makes most sense to identify a range of volumes which are more efficient and more preferable than others. What the institution ought to be aiming for is some optimal combination of efficiency and effectiveness for each of its major subunits. Such combinations obviously need to take into consideration the various interdependencies among units. In doing this, the institution will be aware that some units may be operating at suboptimal volumes in order to increase both the efficiency and effectiveness of other interdependent units. Realizable volumes will most certainly be less than the optimal volume of the overall college, and the preferred combination of efficiency and effectiveness will not necessarily result in utilizing maximum amounts of capacity. In other words, the most preferred or ideal capacity may be some kind of satisficing volume rather than an optimal volume.

A simplified and limited illustration may be helpful here. Providing instructional services requires step-wise movements. Suppose each full-time member of the instructional staff represents the capability of providing 600 student credit hours. As individual full time instructional staff are added to the subunit of the college, its volume capabilities increased in steps of about 600 student hours. Student demand for credit hours, however, is nearly linear. The simplified graph shown in Figure 2. illustrates the problems of fitting a linear progression to a step wise progression. In terms of this simplified graph, ideal volumes in terms of efficiency occur at 600, 1200, 1800, 2400, 3000, and 3600 student credit hours. Least efficient volumes occur at midpoints between ideal volumes: 300, 900, 1500, 2100, 2700, and

3300 student credit hours. Note carefully that gross size does not indicate efficiency. Thirty-three hundred student credit hours with a faculty of six is much less efficient than three thousand student credit hours and a staff of five.

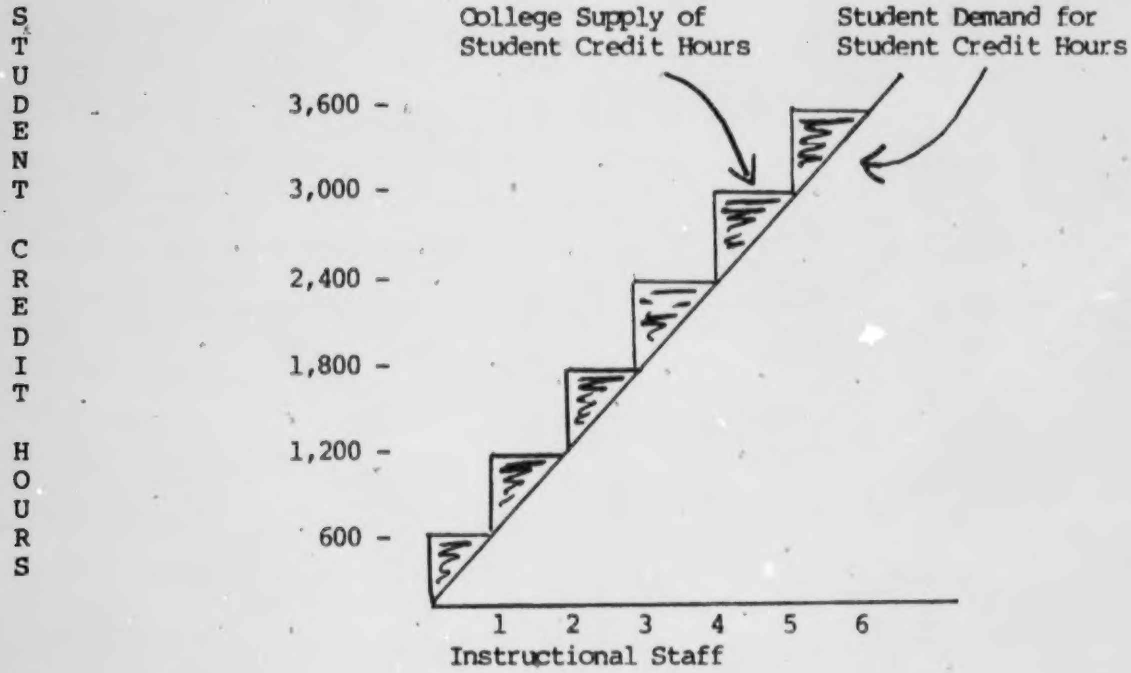

Figure 2.

STUDENT CREDIT HOUR SUPPLY
AND DEMAND EXAMPLE

The use of management information systems in higher education has been criticized for placing too much emphasis on quantitative measures of efficiency and too little emphasis on concerns of quality of effectiveness. By merging the two concepts discussed above, the two management goals of efficiency and effectiveness can be considered simultaneously. The simplified diagram shown in Figure 3 conceptually illustrates how this might be done.

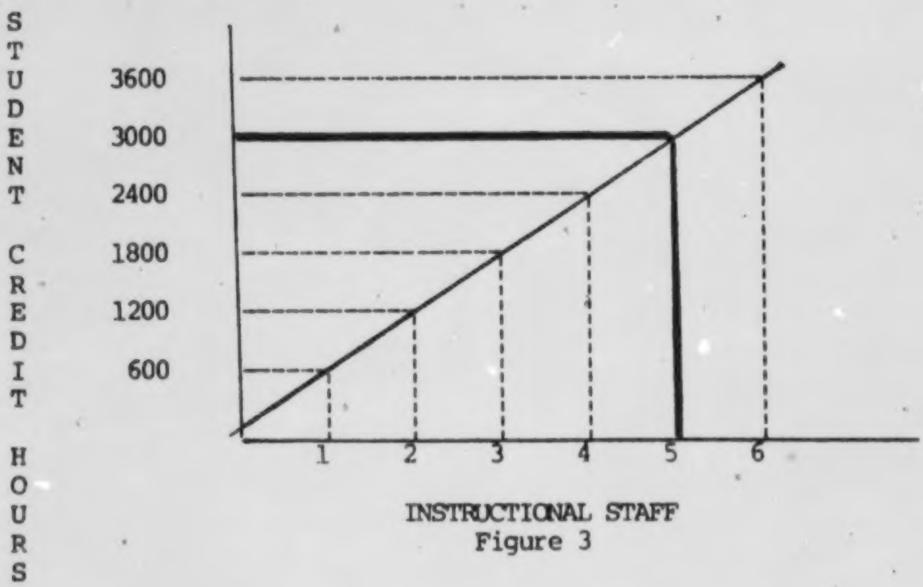

Figure 3

By fitting a linear student demand line to the earlier illustrated five subdisciplined department, concerns of effectiveness and efficiency can be discussed simultanteously and the educational manager can understand how the concerns of effectiveness and efficiency impact each other. The illustrative hypothetical department, in a series of qualitative judgements, established a base capacity of 3000 student credit hours. Therefore, this department would operate at optimal capacity in terms of effectiveness and efficiency at the level of 3000 student credit hours. However, if student demand for this department were to fall below 3000 student credit hours, the department's efficiency would also fall correspondingly. The academic manager would be then faced with the choice of operating in this less efficient fashion in order to preserve the department's effectiveness. Conversely, if student demand were to rise to 3600 student credit hours, the manager would face the possibility of maintaining staff size and increased efficiency and driving the department beyond its ideal effectiveness level (perhaps by increasing class size to 30 students). The increased efficiency (or productivity) could be used to reduce cost, support another department unable to meet its ideal efficiency, or support other measures of quality within the department such as increased travel support or additional equipment. In this fashion, academic managers can understand the "trade-offs" between efficiency and effectiveness and account for their decisions in terms of both efficiency and effectiveness.

Since the institution is made up of the sum of its parts, the institutional managers must seek to make all the parts effective and efficient by calculating the mixes and overall institutional sizes that will lead to effective and efficient operation of parts. In this way, one may conceive different sizes that are both effective and efficient within subunits and the institution. In addition, one may conceive a management strategy or strategies that strives to manage size or sizes in terms of efficiency and effectiveness. Differing sizes and differing mixes can then be modeled which will be both effective and efficient, larger or smaller, depending on particular student demand patterns through periods of time.

Briefly let us consider the matter of institutional flexibility. Flexibility directly concerns the mix of academic programs and capacities that an institution chooses to make available at a particular point in time. Institutional management tends to focus on an annual or even shorter cycle. Thus institutional budgets are prepared on an annual basis and student credit hour delivery and consumption remains relatively stable within each particular year. However, student demand for particular academic program offerings (either in terms of enrollments or student credit hour consumption) does not necessarily run in annual cycles. Changes in student preferences can occur over a much longer cycle. For example, movements away from elementary and secondary teacher preparation are trends evidenced over a number of years rather than in any single period. Similarly, movement towards business or other more vocationally oriented fields such as allied health is part of a multi-year pattern. The decline and subsequent resurgence of enrollments in the engineering field also provides a striking example of the patterns that are possible in terms of student demand cycles.

All of this leads to the observation that it is often wise, if not crucial, for an institution to maintain certain kinds of capacities in terms of academic programs or departments even though these capacities may not be utilized in a totally efficient manner in the short run. Examining questions of institutional size and prospective student demand over a longer (say 5 to 10 year) horizon can lead to interesting conclusions as to the kinds of capacities that need to be maintained for future use. This is particularly relevant when the costs of dismantling and then reconstructing academic capacity is weighed against the short term inefficiencies of maintaining certain kinds of capacity. Furthermore, the goal of persuading students to enter an institution or to pursue higher education mandates a sizeable spectrum of effective academic programs.

Taken together, the three related goals of effectiveness, efficiency, and flexibility provide a basis for managing institutional size. This management needs to be based on the realization that optimality is not simultaneously possible with respect to all three objectives. The academic manager needs to understand the variety of trade-offs between effectiveness, efficiency, and flexibility. In this area, comprehensive management information systems become critical. Understanding and modeling various tradeoff decisions can be supported in large part through management information. When academic managers encounter changing sizes in both subunits and the entire institution (as illustrated by the student credit hour proxies above), a comprehensive MIS can lead management to understand the trade-offs and consequences in terms of efficiency, effectiveness, and flexibility. Thus, for example, information may reveal that expanding student demand for accounting programs may drive the accounting department over its effective level in terms of student credit hour capacity and that this will result in additional efficiencies or lower costs in the accounting area. At the same time, this may permit the maintenance of effectiveness of elementary education programs in the face of decreasing student demand. Sound institutional management needs to know what these trade-offs are, to consider them explicitly across programs and across objectives, to decide when they seem to be satisfactory and also to judge when particular trade-offs are no longer appropriate from the point of view of the overall institution. In determing size, within subunits and for the institution as a whole, the tri-partite goals of effectiveness, efficiency and flexibility stand clearly before the academic manager. Information and knowledge of all three goal areas is necessary to find acceptable options within the constraints that the objectives impose.

In closing, this discussion must be refocused toward the reality of enrollment decline and decreasing student demand. Institutional management cannot compel additional student demand any more than the management of other complex enterprises can guarantee an increasing share of a declining market for each of its members. The system of higher education must face the trauma of downsizing its capacity much as the automobile industry has faced its downsizing trauma.

We have tried to outline a conceptual scheme for facing this trauma and responding to it in ways that recognize some critical principles. Overall declining student demand will not equally affect such diverse programs as the liberal arts, engineering, allied health professions, and other programs among the broad spectrum of higher education. Hence, institutional management must view the size of institutions as the sum of the size of its constituent parts. While efficiency must remain a prime consideration for management, that goal must be balanced by due concern for effectiveness. Otherwise, the institution will have no basis to influence prospective students to select its programs. And without attention to effectiveness, institutions might annually sacrifice programs which might be necessary for prolonged health.

While we have focused on areas susceptible to management control and influence, areas beyond direct management control should obviously not be ignored. For example, the birth rate of 18-25 year olds is clearly out of management control but understanding some of the demographic trends related to that birth rate may be quite useful. Assessing whether the proportion of the age cohort involved in higher education is likely to increase or decrease and what factors will predict increasing or decreasing proportions may be critical from a the educational manager's point of view. Understanding of the specific program capacities that are likely to be most useful in the future may also be a key set of information. Similarly, identifying the factors which influence student demand for education in general and for the program offerings of a particular institution would seem to be a critical set of variables.

We believe the changing size of educational institutions presents academic managers with a traditional problem in a new guise. The impending era in higher education should lead academic managers to make complex sizing decisions based on more comprehensive management information systems. We have tried to suggest here that more and better information is only part of the issue. The really crucial element is the manager's ability to ask the right questions.

DEALING WITH THE UNLOVED WIFE SYNDROME:
SELLING MIS IN HIGHER EDUCATION

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The questionable nature of funding support for colleges and universities is inescapable. The need for better and more information on which to base decisions affecting the future of higher education is equally inescapable. Scarce resources make it extremely difficult to make a larger commitment to the development and support of systems which can furnish data for decision making. Often, the very people in higher education who need information on which to base critical funding and personnel decisions are the most suspicious regarding the funding and support of information systems. Even those who are sympathetic with funding cannot seem to budget the time necessary to insure successful information system development.

This paper explores the elements of these conditions and suggests ways for the professional responsible for information systems to persuade that the investment in such systems will help explain future options rather than confuse them.

The times are clearly out of joint. The word has been delivered. We will have less support for higher education, but will be asked to do more. Anyone who hears even fragmentary accounts of the news can recognize the precarious circumstance of any institution which depends upon public funding for its support. The taxpayer revolt is real. Politicians have gotten the message. Spending will be curtailed. The political winds from the hustings tell the legislators to place the lid on spending; and at the same time, mandates are on colleges from every quarter--educate the handicapped, make women's athletics equal to men's athletics, and provide due process to anyone who has the slightest complaint. Higher education is being called upon to do more and with less money; and the chances are that most colleges will be making a good run at that very dubious goal.

Some loose talk is around these days that higher education should form a modest sized lynching party to find and then dispatch the person who invented formula funding. Many of the most vociferous supporters of the lynching idea forget that formula funding was higher education's idea. The idea was so fair and reasonable in a time when enrollments were on the rise. No one stopped to think, in the 1960's, that the roller coaster of advancing enrollments might just have a deadly downside.

Several moods can be detected among education's leadership. A common one is that of a person on the deck of a sinking ship. Two thoughts predominate. One is that help will arrive at the last minute. The other is that dying should be done with dignity. Higher education is overbuilt and has been for several years. How badly it is overbuilt is being brutally revealed as the impact of declining enrollments become known.

That is the scene. In most institutions of 15,000 students or less, a worried, if not frantic, mind set pervades. More effort must be made to shore up the enrollment. New recruiters must be appointed to help compete for the attention of students coming from the high schools. The competition has two sides; all institutions are stepping up their recruiting activity to gain the attention of the diminished number of students graduating from high school. The problem is compounded by a lower percentage of those few students opting for traditional college educations. The challenge is to attract more students from a smaller supply.

Continuing education is also being emphasized. Identifying the potential for enrollments from persons who already are degreed or who are beyond the typical college age group has become a major center of attention. Non-traditional students, the housewife seeking a professional career and divorced women also are gaining attention as potential enrollment.

Such new opportunities and activities have been featured in higher education for the past generation, but the ones cited here differ in that the activities are needed to maintain enrollments rather than to swell them. These new opportunities, as in the past, require additional resources if they are to be taken advantage of, and new resources must be taken from a steady, if not a diminishing pool of dollars.

The condition is filled with dilemmas. The administration of institutions, especially institutions in the enrollment range of 15,000 and less, are faced with some hobsean choices. Many are faced with the very real prospect of eliminating units or entire programs unless, of course, FIPSE sends a check. Cut-backs in smaller institutions can mean that an entire discipline may be placed in jeopardy or even discontinued in its entirety.

The administrators of colleges during the next two to three years must make critical decisions on allocation or reallocation of resources if their institutions are to remain viable. By 1981, the number of graduates of high schools will be in serious decline. Plans must be made to examine thoroughly, the potential for reallocating existing resources. Staff meetings to address critical funding decisions usually provide moments of special agony. Somewhere, the funds must be found to appoint those new recruiters so that new enrollments do not collapse. The questions to be answered are fundamental. Frustrations and blood pressures rise. The tensions are abnormally high because no one has previously experienced the process. How many students will be affected by the proposed cut? Will the cut yield the resources necessary: (a) to reduce the overall budget commitment in accordance with enrollment, and (b) to furnish the additional funds necessary to staff the positions which will slow or even reverse the enrollment decline? These are the moments which severely test the administration's ability to be decisive and still maintain the confidence of the campus community.

How do you explain to students, faculty, alumni, and others, the rationale for your decision to, say, eliminate the Philosophy Department? Axing a department is not just serious. The shock waves go to foundations. They gain power through a series of natural questions. Is the leadership uncaring of the quality of liberal education imparted to the students? Why not reduce the P.E. Department instead? Why Philosophy? Because it is small? Which small department will be next? Explanations must be given if the administration's integrity is to remain intact. The answers must be reasonable, and their reasonableness must meet minimum standards of academic rigor. Evidence must be presented to justify these decisions and in answer to a new slate of questions. How did the leadership decide on Philosophy? How will the Philosophy decision affect the university's attractiveness to new and transfer students? Will that new staff position for recruitment justify the decision on the shift of resources? What new potential student populations have been targeted, and what are the payoff prospects? The position the administration finds itself in is one which demands massive new quantities of information. The need for information is not new. Administrators have always needed information in order to render good decisions. In the days of expanding enrollments, however, the margin for error was almost unlimited. Now the margin approaches nil. Administrators feel exceptional pressures, and they must have information not just to render reasonable decisions, but to make decisions that can convince the campus community that the decisions, though painful, have the chance of being good ones, and are in the best interests of all concerned. The potential for both lawsuits and bad campus morale make it essential that all decisions are supported by evidence, and that requires good information.

The blunt fact is that good information is not always available to administrators. The information referred to here is not just accurate enrollment data though some colleges would settle for that. The information needed is the stuff that permits the decision makers to examine an issue from as many sides as possible.

Return to the Philosophy Department question. How many students will be affected by the decision to eliminate that program? Are they the better students in the college? If the Philosophy Department is phased out, will the college become less attractive to substantial numbers of the best students? How many faculty members presently are on staff who have enough Philosophy background to continue the offerings on a limited basis? What happens to the courses being taught by the reassigned faculty member if he is released part time from his present assignments?

These are some of the questions that administrators are having to face as they look to the future. They are questions that demand good information if they are to be answered in the best long-term interest of the college. If they are answered without enough information to insure at least a modest chance for success, a college will suffer damage in the short run and can be severely crippled in the long run. One of the ironies of contemporary higher education is that almost any college has the capability of collecting, storing, sorting, and retrieving exactly the kind of information necessary to make good decisions; but it does not have itself organized so that the information can be gathered and retrieved in a fashion so as to be usable when needed. The lack of organization is in large measure, the product of the top administration's ignorance of what can be done to collect and then supply good information. To add to the irony, the persons who can organize, collect, and retrieve the information are ready and often eager to help. Much of the time they are frustrated and feel misunderstood. Some behave as a typical misunderstood housewife. She knows of her worth to the family enterprise, but is not recognized, not appreciated, nor is she made to feel she is an insider on matters of key importance in the life of the head of the house.

Reference to the misunderstood housewives is to those staff members who have the responsibility for the development and the maintenance of management information systems. They are persons who are very competent to develop programs which literally catalog all there is to know about everything in the college and to keep all that data available for the decision makers to be used for both crisis decisions and long-range planning. What we have on one hand is a desperate need for good information on which to base critical decisions regarding the future of the college. On the other hand, we have the capability to deliver the information, but the capability to deliver the information is not being connected in a useful way with those who need the information badly. The remaining part of this presentation will deal with the necessities and the opportunities of making a connection between the administrators who need the information and those who can supply it.

The challenge of developing a management information system is at least four-fold.

1. The management information system people must assume the leadership in selling the concept of management information systems as critically useful to the leadership. Playing the misunderstood housewife role will gain nothing. The systems people must be willing to say forthrightly, that they are willing and ready to invest the time necessary to furnish the administration with the information it needs to reach good decisions. If the systems people are unwilling to do this, the likelihood of a request for their services is not large. Most leadership in colleges, especially the president, is simply not oriented toward the potential for help from systems people. Systems people must be ready to assert themselves as key figures in the institution's future.

2. A second problem is the issue of financial support for the development of information systems. We all know that the development of a management information system is very expensive. It requires personnel, software, and often hardware. From whence shall this new support come? Anyone responsible for systems knows it certainly is not likely to come from the resources allocated to the computer center. All budgets are tight.

3. The prejudices of administrators against the use of computers to solve short- and long-range problems is well known. To the minds of most administrators,

the computer is useful to keep records of the operating funds and to count enrollment. To illustrate the point, a crisis had occurred recently in a college which was severe enough to warrant consideration of reducing staff in two of the college's schools. It was of such proportion that all the upper level administrators had gathered to address the issue. Included among the leadership was the person in charge of information systems. As alternatives were being discussed, the information systems man raised several questions about the adequacy of data on which the alternate decisions were being based. The President declared angrily, "Don't talk to me about numbers. I'm trying to decide which faculty we might let go. These are people with families." He said it as if data and good decisions were mutually exclusive. The prejudice extends beyond computers and information systems. Many presidents do not like numbers. In some institutions, regardless of what the organization chart may say, the business officer is the second most influential person. He is in that position because the president "doesn't like numbers and wishes not to fool with them." This dislike of numbers is common among presidents who come frequently from the ranks of the humanities and social sciences. They have been schooled to be deeply suspicious of anything that would suggest that the value decisions of a college can be quantified. Moreover, the sometime encounters of presidents and vice presidents with computers have been unfortunate. The encounters run from the personal checking account foul-up to the three classes scheduled in the same room on Tuesday at 10:15 a.m.

4. A final concern is how to persuade the administration that good information is important enough to claim a high priority on the time of the top level leadership so that the information systems people can be furnished the guidelines for collecting the appropriate information. Of all the problems to be resolved in developing adequate information, this one is the most serious. Top level administrators are usually in a daily scramble for survival. Their scrambling sets the tone for other administrators and is responsible for the assignment of institutional priorities. Administrators are more beleaguered now than they were even in the late 1960's. Presidents must face the issues of shrinking enrollments, unfriendly legislators, state super boards, equal opportunity programs, access of the handicapped, affirmative action programs, discrimination lawsuits, denials of tenure, Title IX and more money for athletics, legislative post audits, tenured in departments, new information requirements at the state and federal levels, and vastly stepped-up programs to raise private funds. They have no time left to sit down and be reflective about the problems of the present, much less to be contemplative about the problems of the future. Their

condition is much like that of a drowning man who cannot take time to learn to swim because he is so busy keeping from drowning. Somehow, these administrators must be persuaded that their vital institutional best interest will not be served unless they take the time to work with information systems people to collect the data on which to base both present and future decisions.

Now comes the practical advice on how to deal with this four-sided issue. As for being unappreciated, I have nothing very inventive. I would ask you to turn your thoughts to the message sent by one of my favorite cartoon strips. That strip featured good old Charlie Brown who found Lucy in her role as sidewalk psychiatrist, and the doctor's sign said "In." Charlie poured out his troubles. He was unloved, misunderstood, and unappreciated. Lucy listened and barked her solution, "Snap out of it." I would urge information systems people to think positively about the critical contribution they can make to their college and to snap out of the attitude that they can do nothing until the phone rings.

With regard to financial support for the development of a management information system, you should begin with one basic assumption; your college has enough money within its present resources to develop and to install a modest management information system. Most institutions of any size which have been in existence for more than 25 years, have enough money internally to develop an effective management information system. This applies even to the relatively small colleges. In opposition to my point earlier that the computer center has no funds, I would ask you to begin with the budget that supports the computer center and the information systems already in place. I once received a request for a very large budget increase to support the first phases of a comprehensive management information system including personnel, hardware, and software. Seeing those figures was a sobering experience, but I had the bad manners to request of the director that I be furnished with a list of all of the activities presently being undertaken in the computer center and the approximate number of man hours to support each of them. What I received was a revelation. We were doing for other state agencies considerable work for which we were charging a small fraction of the actual cost. We had half a dozen internal projects which were of dubious import to the college, many of which had been installed as a favor to a variety of offices and without reference to college priorities. The one I remember best was an extremely complex program of keeping track of the basketball season ticket holders and making certain that the various contributors to the program had the proper seating. My conclusion was that we could, through a tough-minded approach to the work priorities of the computer center, capture a fair portion of the funding necessary to support the development of a comprehensive management information system. What is true of computer centers is also true of other areas. Priorities can be arranged to claim a considerable amount of funding if the purpose supported by the funding is of sufficiently high priority.

As for dealing with the administration's prejudices against computers, as well as the time problem, I would urge that the information systems people consider some standard sales techniques. Remember, the procedure I am outlining includes the approach that the management information systems people will assume the leadership and further that the resources are available to develop a comprehensive MIS. A third assumption is that the information systems people are willing to do a bit of bootstrapping, that is, they are willing to find some time in addition to their already heavy commitments.

The next step is to get started. The place to make your start is at the top, and that means the president. Think carefully of the possible ways to strike the fires of your president's interest. If you think you can sell the entire MIS package in one fell swoop, plan and make your pitch. I would suggest some caution, however, before that approach is adopted. You should consider using the method of getting the nose of the camel under the tent. The approach you use should be developed after some intense staff discussions on the most probable chance of success. The best rule is "know your audience." If you decide on the camel technique, be resourceful. Pick a hot topic as a point of introduction. Find out what drives the president crazy. Is it the audit report, tenured in departments, pay raises based on longevity, keeping tabs on the athletic scholarships, alumni records? You can find this out rather easily. Ask his secretary or have your secretary ask his secretary. Develop a modest proposal to address the problem and request an audience. You will increase your chances of selling your product if you tell the president's secretary exactly what you propose to discuss. If you've done your homework and picked the right topic, your president will see you. As you develop the proposal, be certain the problem you select can be addressed through MIS data better than it can be addressed through other ways. One of the credibility problems of information systems people is that they have frequently gone to great lengths to produce little. They become so enamored with the process and the challenge of developing the system they lose sight of its product.

Suppose you discover that the alumni president has been hectoring the president because the records are a shambles and hopelessly dated. Your presentation runs as follows: We propose the installation of an on-line Alumni Information System which gives the advantages of having the staff in the Alumni Office, who work with the alumni records daily, effect the actual information updating and receive immediate verification that the update has been correctly executed. Additionally, the data base will always be correct because the update transaction takes less than three seconds to complete. A data base is defined as a nonredundant collection of interrelated data items processable by one or more applications.

Currently, there are over 20,000 alumni records on 1,008 tracks of disk made up of 17 data elements containing 156 bytes per record. The systems hardware includes an IBM 3277 cathode ray tube (CRT) terminal and an IBM 3284 hardcopy printer. System software includes Customer Information Control System (CICS) and Data Language/I(DL/I) to operate the terminals and data base under Disc Operating System/Virtual Storage (DOS/VS). DL/I provides an on-line processor which utilizes a CICS-DL/I interface facility to employ existing user options and exits provided by CICS. Since CICS is a transaction oriented terminal management system, it responds to each transaction as requested and eliminates the elapsed time inherent in both processing systems. Additional software required are the terminal screens and the application programs which control the screens in providing the functions of add, update, delete, and display. File security is accomplished through a series of codes and passwords both internal and external to the system. This prevents unauthorized update of the data base while still allowing some users to inquire non-restricted information.

This on-line concept allows for easy expansion of the data elements of the alumni data base at any time and also allows the Endowment Association to share the data base with its own elements such as donor-giving histories.

If he is a typical president, somewhere midway through the first paragraph, his mind will be on his latest angry phone call from a board member, or better, on his coming weekend of golf.

After you schedule the meeting, I would advise rehearsing the presentation in front of someone who knows nothing of information systems and computer center jargon. The purpose of the rehearsal would be to excise all jargon from what is to be presented. Presidents and administrators could care less about K's of memory, disc drives, ports, iron crosses, interactive computers, on-line capability, and the like. What they want is results, and most have little interest in the means to get those results.

Never approach the president with a generalized proposal. Most presidents will take time to talk with anyone; but when they consider proposals, they want specifics so they can choose among alternatives or at least know the major alternatives. If they want generalized information, they'll let you know. It is relatively easy to go from the specifics to the general in sessions with the president, but it is often impossible to get to specifics if you lose the president's interest by beginning with the general or with jargon-laden detail.

When you take on a project, select one that will be successful. Build the confidence of the president in your ability to use information systems as a valuable tool. If you are successful in gaining an audience with the president but you should happen to catch him on a bad day when he simply isn't interested in the topic you have selected, go to the person who has the greatest influence on the president and use the same approach. He will know of the president's frustrations. The idea is to develop the college leadership's confidence in your ability to supply information that will make critical decisions as good as they can be.

As you sell your service, be certain of your commitments. Set a work schedule and stick with it, giving updated reports according to deadlines. Meeting deadlines is extremely important in building a foundation of confidence.

A word of caution. If you decide to go with the full management information system proposal, keep IBM out of it during your first session. I have the greatest admiration for International Business Machines. It is truly one of the stellar enterprises of all time. No better products, in my judgment, exist. IBM's personnel are, almost without exception, outstanding. Yet I have been to several meetings where IBM people presented a proposal for the installation of a comprehensive management information system before the president and his staff to educate them as to the specific benefits that could come from its installation. I'm not sure what it is, but I suspect that IBM is less than successful because the representatives cannot escape the fact that if you buy MIS, you will probably buy a whole lot more from IBM. The same applies to other vendors. Your purpose will be much better served if you yourself introduce the concept of MIS and its potential for problem solving.

Should you use the camel approach, make sure the nose is responsible for solving a troublesome problem. That way, credibility is built, but beware that in building credibility through a successful project, you may be in danger of losing what you have gained unless you plan carefully. The use made of the computer by administrators is frequently multiplied geometrically once they understand how helpful it can be. When you develop specific projects, therefore, you should keep foremost in your mind the possibility of an early commitment to a full MIS development. You should remember that whatever you develop as a special project to gain the president's confidence should be capable of becoming a part of a comprehensive information system without undue trauma. I have seen it happen. A success or two breeds confidence, and the college administration decides to go full MIS. When the full package is laid before the administration, the segment that produced confidence in the MIS people must be done over in its entirety because it simply will not mesh with the comprehensive system being proposed. Such a situation does not promote confidence. Make a hidden agenda for yourself. Know where you want to go with a comprehensive management information system right from the first moments of that special project. Avoid the custom job. Remember the crisis on which you capitalize in order to gain the confidence of the administration may, at first blush, demand a totally autonomous and custom-made project; but also bear in mind that today's burning issue is likely to be of small importance in future months and years. Know how that special project will mesh with the spine of your MIS.

One final bit of advice. Build yourself a few coalitions. Institutional research people are exceptionally well equipped to understand the scope of the long-term information needs of an institution. They have on-going and ready access to the top leadership because, in most institutions, all information flows through their office.

In summary, if you can sell an entire MIS, I urge you to give it a try. If the importance of the system is not accepted by the university's administration, I would suggest that you consider the incremental approach as outlined above. The first way to deal with the unloved wife syndrome is to stop behaving like an unloved wife; second, make assumptions regarding the availability of funding; and third, build your credibility by producing some valuable and needed services for your institution. Time is running out. We are now in Fiscal Year 1979. We have no more than 18 months to prepare for the grim days of severe enrollment decline. The development of an adequate MIS for your institution may be the most critical effort your college can mount in the forseeable future.

FINANCING THE INFORMATION SYSTEMS RESOURCE IN A PUBLIC EDUCATIONAL INSTITUTION

by

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ABSTRACT

This paper describes and discusses various options for managing effectively the computer resources in a public educational institution. Topics include: purchase versus rental of equipment, an escrow for purchased equipment replacements, plug-compatible equipment, selling computer services, purchasing computer services, facilities management, systems software, and applications software. Case history information is presented pertaining to most of these topics. To a large extent, this paper reflects management philosophy and practices in computer services at Miami-Dade Community College.

INTRODUCTION

If, because of the title, the reader is looking for a secret source of funds in order to avoid the hard decisions of planning and managing computer resources, he or she will be disappointed. Instead, the purpose of this tutorial paper is to provide any computer services director with some ideas concerning the management and conservation of financial resources at a public institution of higher education. Although all the topics discussed have financial implications, some of the topics relate to direct cost savings, while other topics relate to cost avoidances by solving problems before they occur.

Topics discussed in subsequent sections are as follows:

1. Purchase versus Rental of Equipment
2. An Escrow for Purchased Equipment Replacements
3. Plug-Compatible Equipment
4. Selling Computer Services
5. Purchasing Computer Services
6. Facilities Management
7. Systems Software
8. Applications Software

PURCHASE VERSUS RENTAL OF EQUIPMENT

Assume at your institution that your users have expressed a new or revised functional requirement which cannot be met with existing resources. The first step in any procurement cycle is to translate such user requirements into one or more hardware configuration alternatives. (Required operating systems software is considered an integral part of any hardware configuration.)

The next step in the procurement cycle is to select the preferred equipment configuration from the contending ones. Alternatives may represent significant differences on costs, and this consideration alone may determine the preferred configuration.

Assume now that your institution has selected a preferred configuration. Now a decision must be made as to whether to buy or rent the preferred equipment configuration. For purposes of this paper, it is assumed that both rental and capital monies are available. (As a simplification, "leases with rental credits" and "installment purchases" are not explicitly mentioned, but are treated as rentals and purchases respectively.)

Purchasing is usually preferred when most, if not all, of the following occur:

1) The equipment has a practical life of six or more years.
2) The equipment has been available in the market place, and has been in use for at least one year.
3) The equipment is considered to be more "electronic" than "electro-mechanical."
4) It is unlikely that a "new technology"* will be available, or if available, not required within the next six years.

A rental arrangement is usually to be preferred when most, if not all of the following conditions apply:

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*The phrase "new technology" is used in this paper to imply a new way of performing a function. For example, in the case of computer memories, three successive technologies were vacuum tubes, magnetic cores, semiconductors and integrated circuits. With respect to random access storage devices (presently magnetic disks), the next technology might involve lasers or bubble memories. The phrase "new technology" is not meant to imply simply a new model of the same device.

1) The equipment has a practical life of four years or less.
2) The equipment has not been in the market place for at least six months.
3) The equipment is considered to be more "electro-mechanical" than "electronic."
4) It is likely that a new technology will be available and desired within the next four to six years.

The rationale for Item 1 in both sets of criteria follows from the fact that most manufacturers recover the equivalent retail price (excluding interest and maintenance charges) in three-and-a-half to four years of rentals.

Miami-Dade Community College (M-DCC) has followed these criteria with the following examples:

1) M-DCC owns its main computer (an ITEL AS/5-3) and two megabytes of memory.
2) M-DCC owns most of its many minicomputers and remote batch terminals.
3) M-DCC rents its many line printers.
4) M-DCC rents its communications controller (a COMTEN 3650).
5) M-DCC owns its disk system, consisting of four disk controllers and 28 disk drives.
6) M-DCC owns its tape system.
7) M-DCC rents most of its unit record equipment.

M-DCC will probably wish to purchase the recently installed communications controller if its performance remains completely satisfactory, and if its growth potential will accommodate future communications requirements. With respect to the disk system, the practical life of the system was believed to outweigh the disadvantage of its being largely electro-mechanical. M-DCC is presently in the process of replacing the present tape system with a larger and higher speed one using a rental plan. M-DCC is also in the throes of purchasing most unit record equipment since the useful life and rental credits outweigh the electro-mechanical factor.

AN ESCROW FOR PURCHASED EQUIPMENT REPLACEMENTS

One potential drawback of a decision to purchase is the fact that it is reasonable to assume that sometime in the future all hardware will have to be replaced. Because of the bureaucratic constraints in public institutions, it is sometimes much easier to rent rather than to purchase since rental costs can be budgeted and moderately increased year after year after year. Purchase costs, on the other hand, are one-shot affairs, and the replacement one-shot cost should theoretically not occur for several years following purchase.

The solution to the problem of uneven annual purchase costs is to create an escrow fund for purchase of equipment replacements, and simultaneously to budget an appropriate amount related to the amortization of previous purchases per year for equipment replacements. If the budgeted dollars are not used in the subject year for purchases, they should be placed in the escrow account and allowed to earn interest.

In the case of M-DCC, such an escrow account is legal providing it is included under the "fund balance" category and subject to the restrictions thereof, namely, "only ten percent of the appropriated operating funds for public community colleges in Florida can be carried forward." Although M-DCC has not yet begun such an escrow account, it is believed likely that this will occur in the near future.

PLUG-COMPATIBLE EQUIPMENT

This section relates to the use of IBM plug-compatible equipment in place of IBM equipment. Whenever possible, an institution will find it useful and financially rewarding to prepare specifications for competitive bids based on the functional requirements of an equipment configuration. Reliability, availability of maintenance personnel, and the storing of selected spare parts on site can and should be made part of a good specification.

The following two examples involving M-DCC illustrate case histories:

1) M-DCC purchased its main computer, an ITEL AS/5-3, instead of its IBM counterpart, a 370/158-3.
2) M-DCC purchased nearly 80 TCI (now Telex) 277-B visual display terminals instead of their IBM counterparts, 3270's.

In both of these cases, the cost savings to M-DCC was substantial. Equipment reliability and the quality of maintenance was considered (and is still considered) by M-DCC to be equivalent to that supplied by IBM.

M-DCC has, however, made some mistakes in using plug-compatible equipment. Two illustrations will suffice:

1) The first use of non-IBM display tubes was very unsatisfactory because of poor reliability and because of the lack of qualified maintenance personnel locally.
2) The first use of non-IBM printers was unsatisfactory because of rapid print quality degeneration after installation.

> Indeed, this print quality degenerated to the point that users were complaining often and vigorously.

M-DCC is presently experimenting with other non-IBM printers as replacements for the presently-leased two IBM 1403 N1's. The plug-compatible printers appeared to be more cost effective. However, at the time of this writing, the non-IBM printers have not yet met published specifications for speed. The print quality is excellent and equal to that of the IBM printers.

When a computer services director considers using plug-compatible equipment, it is extremely important that vendor maintenance be assured. Without such assurance, plug-compatible equipment should be avoided.

The computer services director should expect to increase his systems staff somewhat if he makes widespread use of plug-compatible equipment. This additional support is required for the selection of the plug-compatible devices, considering all this entails through vendor discussions, site visitations, specification preparation and evaluation of bids. At M-DCC this task is accomplished essentially by one full-time professional person.

SELLING COMPUTER SERVICES

The computer services function of an institution of higher education may often have excess capacity. This can be the case immediately following an upgrade to the main computer or to the memory associated with the main computer. One way to take advantage of this excess capacity is to sell computer services to non-profit organizations. (Selling to profit corporations can involve suspension of certain tax advantages of the institution.)

As a case history, Miami-Dade Community College obtained permission from the M-DCC District Board of Trustees on September 11, 1978 to sell excess computer services to non-profit agencies subject to a schedule of rates established by the president. Since this policy went into effect, agreements have been negotiated for M-DCC to sell computer services to two different departments of a large private university. If an escrow account has been established for purchased equipment replacements, it makes sense for the revenues from such services to be deposited in this escrow account.

One word of caution for computer services directors. Such services should be sold on a not-to-interfere basis with the required services of users at the host institution. Provisions should be written into the contract permitting each party to cancel with reasonable notice. Such services should result in little or negligible impact on computer operations and systems staff at the host institution. The host institution should carefully review its contracts with vendors to see if any educational discounts are voided or affected as a result of the sale of such services. This is not the case with any present M-DCC rental or maintenance agreements.

PURCHASING COMPUTER SERVICES

Often the purchase of certain computer services from a profit or non-profit corporation may be much more attractive than trying to provide such services in-house. M-DCC is presently involved in obtaining the following cost effective services:

1) M-DCC has an agreement with a large airline for running payroll backup in case the M-DCC main computer should not be able to make a payroll run. This agreement requires

that M-DCC make a minimum payment per month to the airline whether or not a backup is required. Fortunately, M-DCC has never had to produce the primary payroll run via the backup. To assure readiness to do this, however, a duplicate payroll is run at the airline about every six months.

2) M-DCC rents BASIC language support from a large public university for the EDP students at South Campus.

FACILITIES MANAGEMENT

"Facilities management" can be defined as the purchasing of certain on-site personnel and management services from a private profit-making corporation. Facilities management may be very useful when one or more of the following problems are present:

1) The management in computer services or in some division of computer services in inadequate.

2) Turnover of personnel in computer services is higher than acceptable norms, resulting in a loss of productivity while positions are vacant or while orientation is taking place for new personnel.

3) The pay schedule and/or employee benefits for computer services personnel is inadequate. Furthermore, institutional policies, procedures and traditions will not permit fast remedial action. This fact may, of course, be largely responsible for problems 1 or 2 above.

4) Computer services, as perceived by users, are poor, inadequate, non-responsive, etc. This fact may likely result from any of the problems listed above.

In the South Florida area, a major facilities management contractor was hired by a large university for both computer operations and computer programming. According to the contractor's literature, problems perceived by university personnel prior to this contract award were as follows:

> The appointed committees did not have to look long or hard for problems in the computer center. The problems were why the committees were established.
>
> There was widespread user dissatisfaction with daily operating performance, and with the quality and quantity of new administrative software applications, and instructional and research services. There was lack of visible evidence of the return on the University's considerable computer investment. The President and Vice Presidents of the University were already attempting to equate the high level of computer center budget with the results for those dollars, and possibly how that same investment could produce more systems and services.
>
> Computing services were big business at the [university], and the computer center staff did not have the depth needed to manage such a resource, nor did it have broad enough experience in systems development to design and implement state-of-the-art systems for administrative and academic users.
>
> As users became increasingly dissatisfied with the level of service available at the [university] computer center, they turned to outside sources to meet their computing and systems development needs. This created fragmented and decentralized computing -- thus increasing computing costs, lowering service levels, and further reducing the University's return on its computer investment. The lack of a master plan for computing meant that such a situation would probably continue.
>
> There was no question about the magnitude of the problem. The question was how much of a turnaround in computing performance could -- and should -- be expected.

Results of the facilities management contract with the university were reported by the contractor as follows:

> Within two years after the contract signing, the [university and contractor] could point to success in a number of areas. The calibre and experience level of the management and technical staff was

> significantly upgraded...The computer center's operating budget had been stabilized at the three-year-earlier level...User participation in computing had increased by 20 percent...The University had increased its return on hardware expenditure by 50 percent...There was 95 percent greater academic and research use of the computer...Regular and ad hoc user seminars were established...Job control standards had been established...New administrative systems development began in accordance with a five-year master plan for computing...The library of programs available to the academic community had been increased from 200 to 1200 programs.

Some personal observations regarding facilities contracts might be useful:

1) On the surface, a facilities management contract will always cost the educational institution more dollars than by not having it, assuming that the same services to users are provided with or without the contract. Nonetheless, a facilities management contract might be cost effective because of improved productivity and cost avoidances. Prior to implementation, the facilities management contract should be determined to be cost effective or the contract should not be written.

2) An institution should never write one facilities contract with the same company for both computer operations and computer programming. Instead, two should be written, each to a different vendor, or the institution should not contract for one of the two named functions. By following this guideline, the institution can maintain full control of each facilities management contract, and the institution can later cancel one or both contracts if it makes sense to do so. If, on the other hand, a single facilities contract is written to the same vendor for all computer

services, it is extremely difficult for the institution not to have to renew such a contract ad infinitum. (As one wag puts it, a single facilities contract for both computer operations and computer programming puts the fox in charge of the hen house.)

3) With respect to a facilities contract for computer programming, it is important to specify criteria for documenting newly developed programs and modifications to existing ones. Furthermore, it will probably be necessary for the institution to have resident staff or consultants ensure that adequate documenting is taking place.

4) Any facilities contract should include a provision so that key personnel cannot be transferred by the contractor in less than a specified time period without permission from the institution. The expression "key personnel" needs to be tightly defined. Also, the facilities contract should include an agreed-upon criterion for annual turnover; turnover beyond this rate to be interpreted by the institution as substandard performance regardless of other considerations. A recommended annual turnover, considering the entire computer services function, would be about 20 percent per year or less.

5) A facilities management contract is an excellent device to clean house quickly. When the political aspects of turning around a bad situation are extremely complex, it might be better to transfer complete control to an

"outsider" for two or three years to get back on track. Unfortunately, however, the usual minimum facilities contract is for a period of seven years.

With regard to the case history previously mentioned, it is interesting to note that the facilities management contract with the large university is presently being terminated because of the following reasons:

1) The university wishes to have better documentation of applications developments than has been produced by the facilities contractor.
2) The university has decided that it would be more cost effective for them to develop improved management at their computing center rather than continuing to pay the facilities contractor.
3) The university discovered that the annual turnover of computer services personnel was about 30 percent, and unacceptable.
4) Several times the university discovered that key personnel were transferred by the contractor with minimal or no notification to the university or sometimes in spite of a contract requirement forbidding this.

As a matter of interest, the institution paid the contractor a little over 190 percent of the direct salary costs for computer operations and computer programming. This overhead of a little over 90 percent was used by the contractor for administration, management, fringe benefits, and profit. The institution reimbursed the contractor for the actual costs for all rental and maintenance charges, and furnished facilities, supplies, utilities and housekeeping services.

The computer programming portion of the facilities contract was terminated recently, and the computer operations portion will be terminated May 31, 1979.

Anyone seriously considering facilities management would find it instructive to read a recent pair of articles in Computerworld (August 14 and August 21, 1978) by Howard Karten titled "WARNING: FM IS NO BARGAIN FOR USERS." These articles make frequent reference to findings of the Brandon Consulting Group and to comments by their president, Dick Brandon.

SYSTEMS SOFTWARE

Systems software is often the most vulnerable area of the computer services function. For that reason it is recommended that only commercially available packages, developed and having met user acceptance, be used by the institution. The reliability and future stability of the firm which developed and markets the software may likely be as important as the quality of software itself.

Documentation of all systems software is mandatory. Such documentation should include the current release number of the software in use and the parameters employed to match environmental conditions. Systems software modifications (or "patches"), which by definition means that vendor-printed documentation and code have been altered in some way, should be minimized, but carefully documented when used. Indeed, if the modification or patch is done in-house, the appropriate supervisor should not permit the systems programmer writing the modification to move on to another task until such documentation is complete and properly filed.

As a case history, Miami-Dade Community College uses the following major systems software packages for its main computer:

1) OS/MVT Operating System (IBM)
2) MINERVA Teleprocessing Monitor* (Diversified Information Systems Corporation)
3) SHADOW II Teleprocessing Monitor* (Altergo)
4) HASP Spooling Program (IBM)
5) PILOT Report Writer and Spooling Program (Eastern Airlines)
6) MARK IV Report Writer (Informatics)
7) RPG Report Writer (IBM)
8) SYNCSORT Sorting Program (Whitlow Computer Systems)
9) COBOL Compiler (IBM)
10) FORTRAN Compiler (IBM)
11) PL/1 Compiler (IBM)**
12) Assembler Compiler (IBM)
13) Assembler Compiler G (University of Waterloo)
14) WATBOL Compiler (University of Waterloo)
15) WATFIV Compiler (University of Waterloo)
16) COBOL Optimizer (CAPEX Corporation)
17) EXECUTOR Operating System Expediter (Allen Service Corporation
18) FDR Fast Disk Dump and Restore (Innovation Data Processing)
19) COMPAKTOR Disk Organizer (Innovation Data Processing)

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*With regard to the teleprocessing monitors, SHADOW II is presently replacing MINERVA.

**RPG and PL/1 are a part of OS/MVT.

20) DCD II File Organizer and Cross-Referencer (CGA Computer Associates)

21) CHIP Source Program Formatter (Software Module Marketing)

22) EASY READER JCL Library Support Tool (Subsystems - Inc.)

23) SUPERWYLBUR Programmer Assist (Optimum Systems, Inc.)

24) BMD Statistical Program System (University of California at Los Angeles)

25) BMDP Statistical Program System (University of California at Los Angeles)

26) SPSS Statistical Program System (SPSS, Inc.)

27) QCM Computer System Accounting Package (Duquesne Systems, Inc.)

All of the systems software listed above have been purchased* by M-DCC with the following exceptions:

1) OS/MVT (including RPG and the PL/1 Compiler) is in the public domain.

2) The HASP Spooling Program is in the public domain.

3) SYNCSORT is being rented.

4) The COBOL Compiler is being rented.

5) The FORTRAN Compiler is in the public domain.

6) The Assembler Compiler G is being rented.

7) The WATBOL Compiler is being rented.

8) The WATFIV Compiler is being rented.

M-DCC is currently paying a maintenance fee for most of the software purchased and in the public domain.

The judicious selection and use of systems software can be of great value in managing computer services resources. For example, the COBOL Optimizer has markedly improved the operating time of applications programs at Miami-Dade Community College. Also, the QCM Accounting Package has been and continues to be very helpful in surfacing information relating to computer system component saturations and unused capacities.

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*The term "purchased" may imply acquiring an indefinte license to use a proprietary product.

The rather large list of systems software discussed in this section was selected and installed over a period of several years. This entire library of systems software is maintained by two systems programmers with over 12 years of experience at M-DCC between them.

APPLICATIONS SOFTWARE

When a very large computer applications development is initiated, the computer services director should first determine the suitability of using any commercially available packages, especially those with more than one year of use in a similar educational environment. This determination should be done cooperatively with users to the maximum extent practical. These commercial programs will usually be less expensive and more expedient to purchase than those developed in-house. Of course, interface programs must still be written so that the purchased software can properly relate to sotfware already in place.

Miami-Dade Community College has not, in the past, been successful in finding suitable commercially available applications software; consequently, all developments have been in-house, with the single exception of FAMIS. M-DCC has, however, contracted for two developments, one of which was unsuccessful and had to be restarted from scratch by Miami-Dade Community College analysts and programmers. The other applications development was written in FORTRAN. Since all the M-DCC programmers are COBOL-trained, maintenance of this system continues to be a problem, and M-DCC has found it more expedient to purchase maintenance (from the original developer) rather than attempt to maintain the system in-house.

In the future, Miami-Dade Community College expects to purchase applications software whenever possible. A likely example is the probable replacement for our antiquated general ledger system and related business programs.

At present M-DCC has about 630 active computer applications programs, an increase of about 10 percent in one year in spite of vigorous purging activities to remove inactive or obsolete programs. Usually a program is placed in an "inactive" status if it has not been used for one year, a status indicating that no maintenance will be performed. At this time the user, if he can be identified, is asked to release the program. After two years of no use, the computer program is automatically purged.

CLOSING REMARKS

The author has attempted in this paper to describe several ways for a computer services director in higher education to manage effectively the resources available for such services. Topics discussed were illustrated with case histories from Miami-Dade Community College or other educational institutions in South Florida. This paper was not intended to be a thorough treatise of any of the topics discussed. Many papers, chapters, or even books are available on the topics discussed.

The author invites any inquiries or comments regarding this paper.

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A CONSERVATIVE APPROACH TO SYSTEM DESIGN

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An information system need not use state-of-the-art technology in order to be optimal for a given institution. Budgetary restrictions, unsophisticated data processing users, and the political environment can combine to produce a situation which calls for a conservative approach to designing and implementing a new system. Cornell University has recently replaced its outdated Student Records and Registration System with a batch oriented system. Although the new system is less powerful and certainly less technically attractive than an on-line system, it was relatively inexpensive to develop, is inexpensive to operate, and fills the basic needs of the university. This paper describes the considerations that motivated Cornell to follow this conservative course of action. It also briefly describes the new Student Records and Registration System.

Environment for Change

Technical Considerations

In 1976, the Student Records and Registration System (SRRS) in use at Cornell was typical of an early 1960's record processing operation. It was a card oriented system using an IBM 360/20 computer with multi-function card machine features, many IBM 1401 computer programs, and several pieces of unit record equipment (card sorters, interpreters, etc.). The situation was complicated by the fact that the IBM 1401 administrative computer (and several other computers) had been replaced years earlier by an IBM 360/65 computer. (Cornell now uses a 370/168 machine.) Although the 1401 computer had been replaced, the programs that executed on it still had to be used, so a simulation package was purchased which allowed 1401 programs to be run on the 360/65 machine.

The old student records system was predominately punched card oriented, involving a great deal of manual processing. Many of the essential files existed only in card format. Tape files were used primarily for internal processing. There was neither editing nor validity checking of input, and no turnaround documents nor audit trails to indicate the contents of the files. The data stored in the files was therefore very inaccurate and unreliable. A copy of the Student Master File was kept on magnetic tape. However, the tape file had a corresponding card file, which was used by the college offices for record keeping. If a student withdrew, his card was thrown away. Changes and additions were written on the cards or on blank cards, and the changed cards were marked with a paper clip. Periodically, these cards were returned to the computer center and used to update and purge the central files. A new set of cards was then punched and sent to the various college offices. The central tape file was almost always out of date, since changes reported to college offices were not made in the central files in a timely manner.

A serious problem with the old system was turnaround time. For example, it took months to keypunch changed demographic information to update the Student Master File at the beginning of each semester. Because of this, each student was given a packet of ten computer cards at registration. A student's identifying information was printed and punched on each card in the packet. Each student had to write his current address and other demographic information on each card every semester. The cards were then collected, sorted, and sent to the academic and administrative offices. The information written by the students might vary from card to card. Competition developed among the offices for updated information, since a student might report an address change to one or two offices, but not to eight or ten. Registration was a drawn out process, since students picked up their packets several days before registration to have time to fill out all of the cards.

From a technical standpoint, the system was rapidly becoming unmaintainable. The ability to modify 1401 Autocoder programs and to write RPG programs for the 360/20 computer were becoming obsolete skills at Cornell, since the university had decided to concentrate on higher level languages like PL/I and COBOL. For several years, maintenance had been done on an ad-hoc basis, due to the anticipated installation of a new system. An increasing number of PL/I programs were written to correct known flaws in the old system by manipulating the files between runs of 1401 programs. Technical documentation did not exist for most of the programs in the system.

User Considerations

Although the academic offices were generally satisfied with the old system, it was unsatisfactory for the executive offices of the university, since state and federal reporting requirements could not be met economically in a timely fashion. As the number and complexity of legally mandated reports increased throughout the 1970's, this problem became more severe. The absence of user documentation was also a serious problem. The academic offices knew how to use the system, but any staff turnover caused problems, and the manual workload was excessively time consuming.

Control of the system, such as it was, was completely distributed. There was little exchange of information among the various offices, and little impetus to provide data to the University Registrar. Updating of the Student Master File was haphazard at best. Working files were maintained manually by the college registrars, who were not concerned with the information in the central files.

The organizational structure of the academic offices at Cornell is a curious one. There is a central University

Registrar, who reports to a vice-provost. The Registrar's Office is responsible for transcripts, reporting, and central record keeping. The college registrar positions are lower in the organizational structure than the university registrar position, but the college registrars are not subordinate to the University Registrar. Each reports to the dean of his respective college, who in turn reports to the Provost. Each college registrar keeps records pertaining to the students in his college, and is responsible for such things as section balancing, classroom assignments, screening of students enrolling in courses, and degree certification of students.

The college registrars are accustomed to a great deal of independence, both from the University Registrar and from each other. Due to a lack of training in modern computer techniques, they are not sophisticated data processing users, and were therefore not prepared to assimilate easily changes in their data processing operation.

Political Considerations

A major factor affecting the environment for change was the failure of a previous large development project to replace the old student records system. Since the late 1960's, plans had been made to install a state-of-the-art student records system. Money had been allocated for this project, and arrangements had been made with an outside vendor to supply the system. The repercussions from the failure of this project were great. First, the university had spent a substantial sum of money with no useful results and was unwilling to underwrite a second large development project. Second, the long term economic situation was changing both for the country and for the university, and there was increasing concern that operating costs be kept to an absolute minimum. At about this time, the University President declared a moratorium on development of new data processing systems. The programming department staffing level was reduced drastically, and all systems analyst positions were eliminated.

The available options for processing student records were on-going maintenance of the old system, a modest in-house project to replace the old system, or purchase of an existing system. Studies were made of these alternatives, including investigation of several available systems from software vendors and other educational institutions. Based on requirements studies and financial studies, the decision was made to "rehabilitate" the old system by doing a functional replacement in-house. The new system would perform essentially the same functions as the old system, only using more modern technology.

Project Goals

The three primary goals of the rehabilitation project were: (1) to replace the old system with a new system performing essentially the same functions but using modern data processing techniques; (2) to maintain production costs within the limits of the old system; and (3) to simplify the system to be as economical, accurate, and reliable as possible within the imposed budgetary restrictions. Constraints were that the new system must be installed without undue disruption in processing student records, that the reporting needs of the university must be fulfilled accurately and reliably, and that the special card handling performed by the 360/20 computer must be eliminated so that the machine could be phased out. Minor enhancements could be done at the request of the users if time and budget allowed, but larger enhancements requiring additional funding must wait.

Project Team

A project team was formed from existing university personnel. The project director was the Associate University Registrar. Two staff members from the Administrative Programming Services group were assigned to the project as technical manager and senior analyst. The Registrar's Office also supplied one programmer. A users' group consisting of several of the college registrars was selected by the Vice-Provost to act as an advising and consulting body. Figure 1 shows the project organization. The line drawn between the college registrars and the project team indicates the users' group working arrangement, and the line drawn between the project team and the Assistant Director for Administrative Programming indicates that the project technical manager prepared status reports on the progress of the project for the data processing organization. The project was begun in July 1976. Implementation was scheduled to be completed in two years, i.e., by the beginning of Fall semester 1978.

Project Organization

```
                ------------
                | Provost |
                ------------
                   |        |
       -----------      ----------------
       | College |      | Vice-Provost |
       |  Deans  |      ----------------
       -----------          |
           |                |
      -------------    ----------------------    -----------------
      |  College  |..|  Associate Registrar  |..| Asst. Director |
      | Registrars |  |          and          |  | Administrative |
      -------------   | Project Team Members |  |  Programming   |
                      ----------------------    -----------------
```

Figure 1

Description of the SRRS System

System Design Considerations

Several problems were encountered while designing the rehabilitated system. The users were unfamiliar with modern computing operations and had difficulty visualizing data processing concepts and suggestions. Their unfamiliarity with data processing terminology led to difficulties in defining in data processing terms the functions that were to be replaced. In addition, the users had just experienced a system implementation failure in which they had started to convert to a new system and then had to frantically convert back. This failure generated a lack of confidence in any new computer system.

Initially there was interest in an on-line system, and various studies were made of this approach. A large part of this interest was due to misconceptions on the part of the college registrars as to what operating an on-line system would require. Given the economic conditions at the time, the university administration was unable to spend the required amount of money on hardware purchases, and the college deans were unable to hire additional staff (installation of an on-line system would probably require the hiring of data processing oriented personnel to operate it), so this alternative was dropped fairly quickly.

The best approach was a batch system with optical mark input for large scale data entry. Keeping the files on tape would be relatively inexpensive and would eliminate backup procedures. The major change from the viewpoint of the users was that the central files would be the main files, and the college offices' files would be the subsidiary files. This represented a substantial change in policy, but one that was necessary if the university was to continue to receive state and federal funds, since it is the only way to provide the required reports reliably and accurately.

System Modules

Five functional areas were identified: the Course Module, the Student Module, the Course Enrollment Module, the Grade Module, and the Registration Module. Figure 2 shows the relationships among the system modules. The installation of this system proceeded on a phased schedule. The modules were installed independently to preserve continuity and to make user training easier. Each of the modules was installed as it was completed. Conversion programs were written to interface the new system to the parts of the old system that had not yet been replaced. Although this implementation schedule necessitated the project team spending considerable effort writing conversion programs that were only used for a short time, it eased the system in gently and made the conversion less of a jolt for the users. The entire system is written in structured and optimized PL/I code.

SRRS System Modules

```
         ----------                           -----------
       1 | Course |                         2 | Student |
         | Module |------             -----| Module  |
         ----------     |             |     -----------
              |         |             |      |      |
              |    --------------------      |      |
              |  3 |    Course      |        |      |
              |    |  Enrollment    |        |      |
              |    |    Module      |        |      |
              |    ------------------        |      |
              |          |                   |      |
              |          |                   |      |
            -----------                      |      |
          4 |  Grade  |-----------------------      |
            | Module  |            ----------------------
            -----------          5 | Registration  |
                                   |    Module     |
                                   -----------------
```

Figure 2

The Course Module handles information describing all courses offered by the university. This module includes the maintenance of the Course File and the production of the course rosters. The Course Module was chosen as the first to be implemented since it is the smallest and simplest subsystem, and because the interfaces back to the old system were the cleanest. Work on the Course Module began in July 1976 and was completed in October 1976 in time to be used for Spring semester 1977.

The Student Module handles all student demographic information. A major change from the old system is the inclusion in the Student Master File of individuals who are not currently registered students, making it easier to reinstate students who return from leaves or suspensions since their records are still in the computer file. This module includes the report programs involving demographic information about students that are required by the university and by the state and federal governments. Work on the Student Module began in October 1976 and was completed in July 1977 in time to be used for Fall semester 1977.

The Course Enrollment Module uses both course and student information. This module manages the Course Enrollment File, produces student schedules, and prepares the final examination schedule. The implementation of this module required the first large scale change in operations for the college registrars and students. Previously, the students filled out schedule forms. The college registrars placed students in courses by putting a punched card containing a student's name behind a punched card containing the identifier of a course in which the student wished to be enrolled. The new system completely eliminates this card handling. Instead, students fill out optical mark forms indicating the courses they want to take. Although this method is not as elegant as an on-line system, it does allow a large amount of data to be processed in a short time. Work on the Course Enrollment Module began in July 1977 and was completed in November 1977 in time to be used for Spring semester 1978.

The Grade Module implementation caused the first major change of procedure for the faculty. Formerly, grades were recorded by marking a grade for each student on a separate computer card. The cards were read by a card processing machine, which translated the marks into punches on the card. The cards were then read into the computer. This was a time consuming process, subject to many different types of errors. The process was replaced by printing optical mark grade sheets for each course, with up to thirty-five students on a single sheet. The Grade Module includes the programs required to maintain the grade file and to produce numerous grading reports. Work on the Grade Module began in November 1977 and was completed in May 1978 in time to be used for Spring semester 1978.

The Registration Module handles university registration and produces reports for the administrative and college offices. In the former method of registration, students filled out as many as ten pre-punched computer cards with their new demographic information. The cards were sorted and sent to different offices. The new method replaces all of the cards with one optical mark form that the students use to register with the university. There are additional optical mark forms to report changed demographic information to the University Registrar's Office. After registration, reports are produced for the university administrative offices and the college offices giving up to date information from the Student Master File. Work on the Registration Module began in May 1978 and was completed in August 1978 in time to be used for Fall semester 1978.

System Files

Four primary tape files and several secondary tape and disk files contain the information used by the system. The Course File, the Student Master File, the Course Enrollment File, and the Grade File are the primary files. In addition, a Student Schedule File is constructed from the Course Enrollment File and the Student Master File, and a Term and Cumulative Average File is constructed from the Grade File and the Student Master File. The system contains two auxiliary direct access files containing information concerning programs of study (majors) and members of the faculty. These two disk files are used for editing purposes when information is entered into the Student Master File. A file of system tables stored on disk is also used for editing and report generation. These tables are dynamically loaded when needed and can be changed without modifying any of the computer programs that comprise the system.

The decision to use sequential tape files rather than direct access or indexed sequential files was a result of financial considerations and a requirement that the system be run in a batch, rather than an on-line, mode. The requirement for a batch, rather than an on-line, system was imposed for reasons of cost and data security. The new system was mandated to run within the same operating budget as the system it replaced. That system was relatively inexpensive, since it was a card oriented system and did relatively little. In addition, the administration at the time the system was designed was not convinced that an on-line system could be written that would have adequate privacy safeguards. Since the charging algorithms on Cornell's IBM 370/168 computer are heavily weighted against input and output operations, the best way of meeting the financial limitations was to design the system using tape files with large blocking factors. Since most of the processing involves sequential passes through entire files, very little is lost by using a sequential file organization. The use of tape files also eliminates the need for special backup procedures, since an update to a file always produces a new file while leaving the old file intact.

In keeping with the conservative nature of the system, and to minimize the size of the files (and therefore the costs), the files contain only the information that is absolutely needed for use by the University Registrar's Office or for external reporting requirements. It was further decided that only information that would be verified and maintained accurately would be stored.

Input and Output Media

Three types of input media are used in the system. Computer generated turnaround documents are used for Course File updating, keypunch input forms are used for maintenance of all files, and optical mark forms are used for large scale data collection for course enrollment, grading, and university registration.

To reduce costs, the number of special forms needed for output has been substantially reduced. Most reports that are produced are printed on standard computer paper. However, many special forms are still required, especially for student schedules, grading, and university registration.

The introduction of computer output microfiche (COM) as a partial replacement for printed output was a significant innovation. Several college offices and the University Registrar's Office purchased microfiche readers and receive reports on fiche. Cornell purchased a microfiche system and produces the microfiche directly from computer tape in-house in a very timely fashion.

Conclusion

In an era when universities are turning increasingly to advanced on-line systems for their data processing needs, Cornell decided on a much more conservative approach. Rather than attempting to give each user whatever he thought would be useful, a very modest project was undertaken to replace an obsolete system with one that was maintainable, inexpensive, reliable, and filled the minimum needs of the university. Policy changes were kept to an absolute minimum.

The resulting system, while certainly not a showpiece, does in fact perform all the necessary functions within the specified production budget. In addition, the development project was completed on time and within budget. The complete system is now being operated in production by the same personnel that operated the old system, with no more than the usual staff turnover rate.

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ORGANIZATIONAL CHARACTERISTICS OF A UNIVERSITY: IMPLICATIONS FOR DESIGN AND USE OF INFORMATION SYSTEMS

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ABSTRACT: The characteristics of a university as a complex social organization and the ways in which these characteristics are embodied in a particular institution are important considerations in developing and applying information systems to assist in administration. Included in "organizational characteristics" are: (1) structure of the organization, (2) behavioral considerations, and (3) information and decision processes.

A simple cybernetic model is proposed to illustrate administrative relationships within the university, to explore the influence of the foregoing organizational characteristics on the functioning of the institution, and to determine implications for the design and application of information systems. Using this model, principles are proposed to assist university administrators to play a more effective role in defining information to be derived from basic institutional data, in specifying the ways in which information will be used, and in distinguishing problems related to the institution's constraints or other characteristics from shortcomings in the information system.

I. Universities as Organizations

If one wished to design a university from scratch, the very first step would undoubtedly be a study of the environment in which it would function. Certain questions of strategy would need to be faced at the outset: Who would be the clients? What kinds of programs? Who would provide support? What are the constraints? The answers to questions such as these would determine which features of the environment are relevant for goal setting, and, having established goals and measurable surrogates for these goals, design of the university could begin.

The issues of organization design come to focus most sharply in fashioning the activities needed to produce the outcomes. It is at this juncture that the other design variables--structure, people, and information and decision processes--come into play. This inferential process is shown schematically in Figure 1.

Few persons have had the luxury of designing a university from scratch. But we can examine our activities (not addressed in this presentation) and seek to understand the unique features of a university which affect the way in which these activities are carried out.

Structure

One of the most noteworthy characteristics of a university is the existence of an organizational structure which differs markedly from the program structure. The major units of most universities are colleges or schools which are further subdivided into departments. This division and subdivision is along disciplinary lines reflecting the special areas of expertise of the faculty, e.g., physics, geology, English, mathematics,

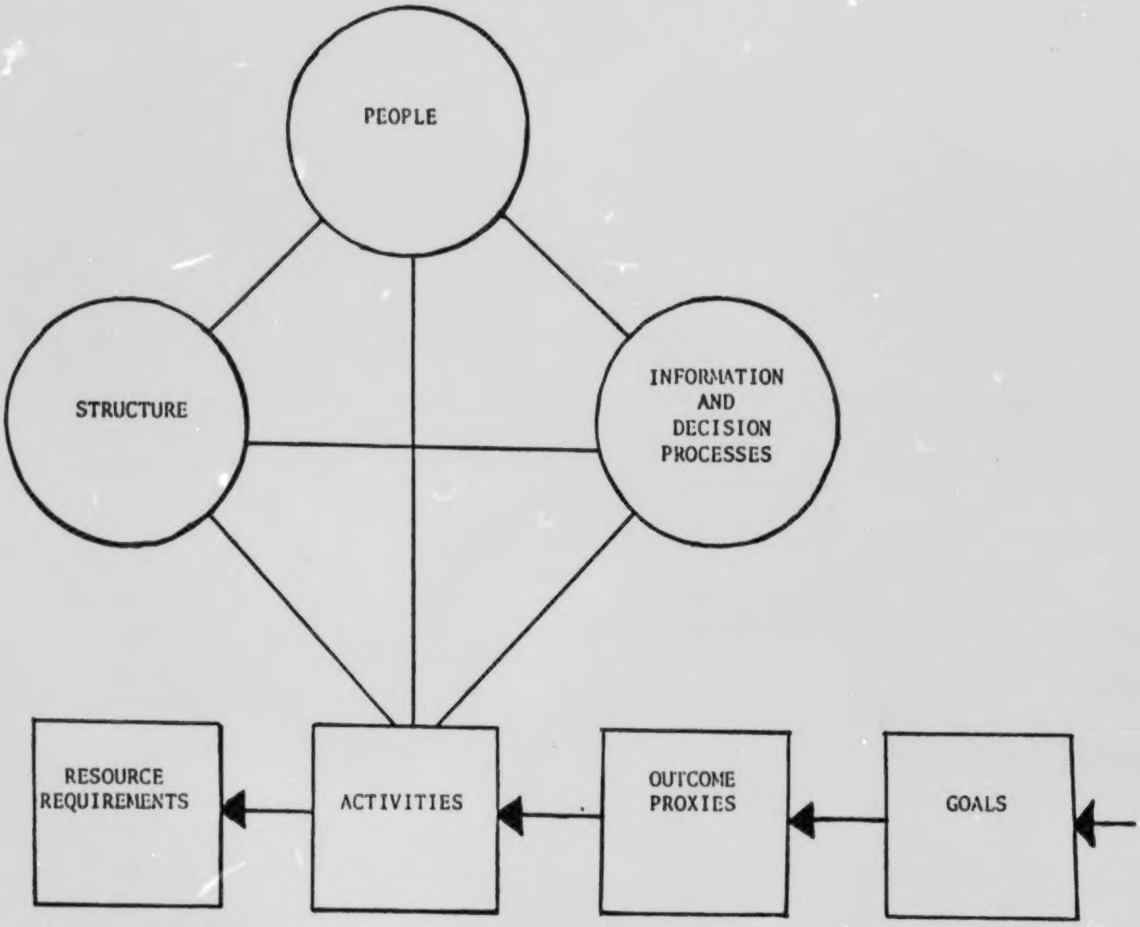

Figure 1. Schematic representation of the issues (People, Structure, Activities, and the Information and Decision Processes) in the design of an organization.

etc., in a college of arts and sciences and departments of accounting, marketing, etc., in a business college. Each department is engaged in activities of teaching, research, and service, but these are not fully organized around the same departmental structure. For example, while the mathematics department may have undergraduate and graduate majors, as much as 95% of its teaching may serve students majoring in other departments and colleges.

Recruitment of faculty is done by discipline; reputation is by discipline; evaluation of research performance is by discipline. Commitment to a departmental community is thus often stronger than commitment to other motivating groups. It is not my purpose to propose a change in that arrangement. I seek only to draw attention to the fact that the university organizes itself in a multiplicity of ways.

Universities tend to be flat (horizontal) organizations--built along traditional disciplinary rather than functional or programmatic lines--with many of the key decisions made in largely independent local units. The foregoing characteristics, often described as representing a "decentralized" structure, have important implications for the design and use of information systems.

People

The university is a very special place for learning where healthy people are transformed, not just in the way which the organization seeks to transform them, but also in the way the people want. If the university is doing its job well both students *and* faculty are learning and being transformed. The existence of a set of ideals concerning the value and meaning of a university and its function in a broader learning community makes possible an organization which can be effective despite the fact that a significant fraction of what each faculty member does is not the result of a direct assignment. The work is seen to be intrinsically rewarding. The degree of self-motivation is usually high and, as a result, allegiance to higher ideals can compete favorably with other more personal and local concerns. This may also help to account for the fact that the university can function effectively despite the lack of congruence between the organizational and program structures noted above.

In addition to what I have called the *broader learning community*, I wish to distinguish three other communities in which the faculty member is involved in his or her work. The first is also an extramural community, the *professional community* represented by the discipline (under which I subsume allegiance to professional societies). Another is the *university community*. The last is the *departmental community*.

Allegiance to the professional community helps to explain the strength and durability of the disciplinary departmental community to which it is linked.

Similarly, the broader learning community finds, or should find, its local embodiment in the university community.

The reward structure for faculty--in terms such as promotion, tenure, merit salary increases--inheres first in departmental peer judgments. These values of the departmental peers are strongly influenced by the ideals of the broader learning community and the expectations of the disciplinary community and less strongly by the local university community.

While the local university community can be influential in peer judgments, I believe that its capacity for effecting significant deviations from the peer group norms is usually overestimated. Those who make assertions such as: "Good advising would be rewarded if only the university (meaning the president) would make a strong statement," are blowing in the wind. At least at this point in time the university community appears to play a subsidiary role in determining rewards.

Information and Decision Processes

Just as only a fraction of what a faculty member does is directly prescribed, so too the university should be a place where many things happen, some of which are not determined in advance. This is especially true in terms of the development of new knowledge and new ways of organizing and interpreting old knowledge. A true learning community must change and be open. Perhaps it is in recognition of this, or perhaps it is totally unrelated, that the information and decision processes in universities sometimes seem to be ambiguous or poorly developed or integrated.

Earlier it was pointed out that the university organizes itself multiply and that there are several communities in which each faculty member holds membership. Decision processes in the university are similarly complicated. At the outset, there is a distinction to be drawn between the *administration* of the institution and its *governance*--the latter embodied in terms such as "the Senate" or "the Faculty of the College." While in most universities it is possible in theory to separate the proper domain of the governance and administrative mechanisms, in practice the potential for overlap and ambiguity is sufficiently great to create tensions.

Often the decision of a governance group is "legislative" or "judicial" in scope--it legitimates, authorizes, or recommends for or against. Its negative power is greater than its affirmative power. It can prevent something from being done but it usually cannot, by itself, implement a positive decision. The decision of an administrator, on the other hand, is often "executive" in scope, i.e., it carries with it the mechanism for implementation.

This historical separation between administration and governance may be partly responsible for the low esteem in which both faculty and administrators have held activities such as planning. During the period of growth in the sixties it was not necessary to make many choices. An individual faculty member could propose a program with little attention to anything beyond "academic concerns" and with the expectation that the administration would dutifully allocate the resources needed for implementation. Basic assumptions were seldom questioned. Constraints seldom played a critical role. These expectations persisted even after resources were no longer plentiful and, when "nothing happened" as a result of a planning "exercise," planning itself was damned as being irrelevant to a university. Administrators were unable and unwilling to respond to what they viewed as "pie in the sky" proposals. Faculty saw administrators come and go and, no matter what processes were involved, little happened. This impasse was partly a matter of perception--a contrast to the ease with which things happened during the growth period--and partly a matter of reality stemming from the inappropriateness of the incremental nature of the planning and decision processes which had evolved.

Thus far I have drawn a distinction between administrative and governance roles. At this stage it seems appropriate to associate the word "administration" with what I shall call hierarchical decision processes and to associate the word "governance" with collegial processes.

Hierarchical decision processes rely on the common concept of bureaucracy. Collegial decision processes are based on the model of a university as a community of scholars which shares in decision making. In the latter picture, rationality and consensus are assumed to dominate and authority is derived from knowledge, not position. These characteristics are commonly posited for the faculty committee structure and for entities such as the university senate. They are also assumed to be the basis for the peer review system for promotion, tenure, and reappointment decisions.

In practice, the formal decision processes of the university usually involve *both* hierarchical and collegial features. These features are, moreover, only approximations of the ideals of either model and they are linked in complex or ambiguous ways. Formal communication in the university tends to follow the structural (bureaucratic) lines and such communication is believed to be notoriously poor. Much of this problem stems from the difficulty in passing information from a line representing a hierarchical process to one which is more appropriately described as collegial. Department chairpersons and deans are astride an orthogonal intersection between a vertical, hierarchical communication channel and a lateral, collegial channel. It is not surprising that this can, at times, lead to communication failures.

Whatever the tensions, both hierarchical and collegial processes coexist in most universities and represent a relatively effective, if not efficient, path to most decisions. There is yet another dimension, however, which limits the authority of hierarchical and collegial processes and which, on occasion, dominates decisions. That is the existence of a political component in decision processes which can come to the fore in a time of crisis or when a particular issue rallies a segment of the university community. Such events test the strength of the extant formal processes and often worsen the tension which ordinarily exists. Moreover, the form and function of the hierarchical and collegial processes is, in turn, influenced by the potential for politicization. Thus the full description of decisions in universities involves attention to all three forms--the hierarchical (or bureaucratic), the collegial, and the political.

II. A Cybernetic Model

Reversing the Arrows

Figure 1 illustrated an inferential process for arguing from issues of goal definition, to the specification of activities, and ultimately to the resources required by an organization--for the purpose of designing the organization or, in the case of an existing organization, for the purpose of improving understanding. In order to build a model for the *operation* of an organization, we begin by reversing the arrows in Figure 1. The box entitled "goals" becomes "outcomes" when the direction of the arrows is reversed and "resource requirements" becomes "resource allocation."

With the addition of boxes and lines representing key actors and the flow of information and decisions, the model is now ready to operate. It is illustrated in Figure 2.

The box entitled "resources" in the model represents those material assets which can be allocated to carry on the work of the university--money (to purchase equipment, to pay operating costs, to provide compensation for faculty and support staff), space (in which to carry out the activities), and support services (for example, library acquisitions, computer time and other separately budgeted support functions). Although infor-

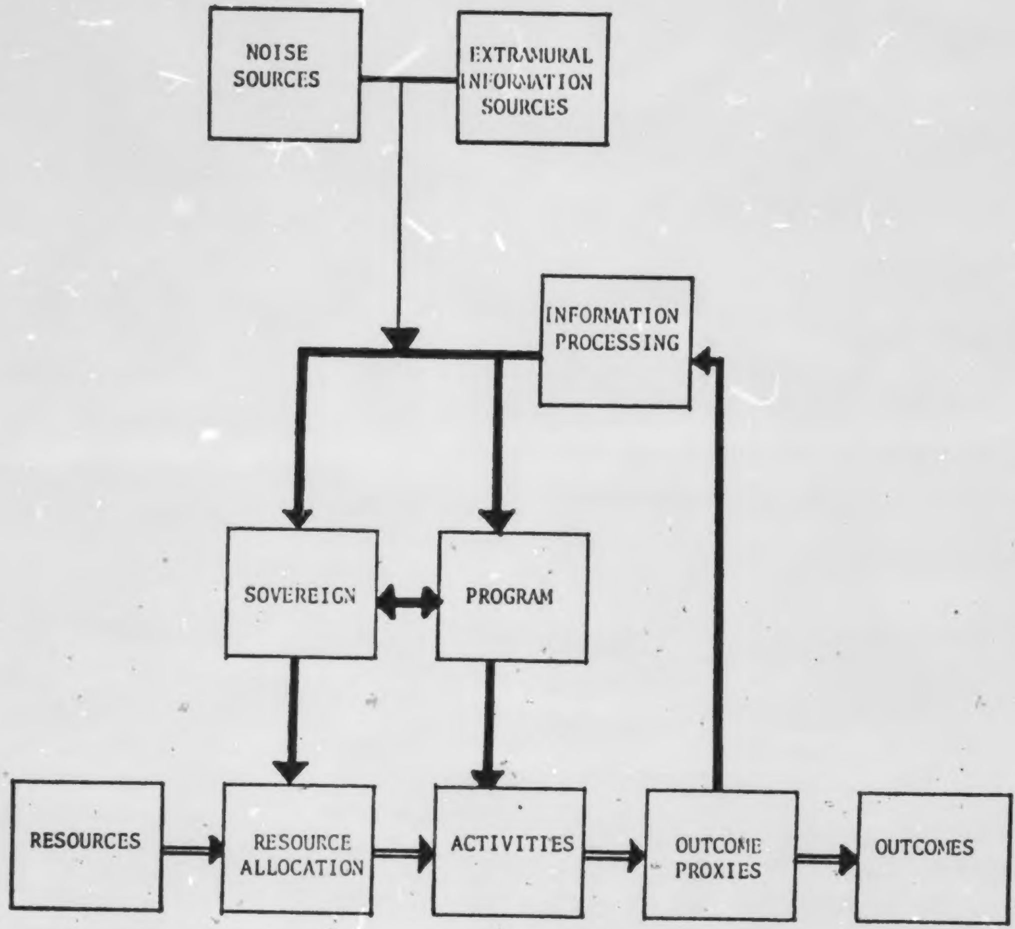

Figure 2. A simple cybernetic model to represent administrative relationships within a university. The sovereign (for example, dean) allocates resources to the program (for example, department including the chairman, faculty, and staff) so that the program can engage in certain activities aimed at producing particular general outcomes. The sovereign and the program communicate with one another and each receives official internal information, represented here as "outcome proxies," after processing, as well as signals from noise sources and extramural information sources.

mation is an important resource it enters the system elsewhere in this model and hence is not included in the "resources" box. Similarly, students who provide some of the dollars in the "resources" box also bring their brains as important input to the system but the latter enter the system in the box entitled "activities" and are not shown explicitly on the diagram.

The model is capable of representing a variety of administrative relationships. For example, the sovereign would ordinarily be a dean if the program is a department. However, the model works equally well if sovereign is taken to mean the president and program equals college or if the sovereign is imagined to be a state governing board and the program is an entire university.

The Sovereign

The choice of the word "sovereign" to represent the administrator who has ultimate authority in a decision concerning the program represents an intentional overstatement. As was pointed out in Section 1, the university is a relatively open and complex system, a highly decentralized organization in which much of what takes place is not prescribed. Moreover, much power resides in collegial processes, which along with the hierarchical processes, are in turn limited by the potential for political activity within the organization.

This should not lead to the extreme conclusion that the administrator is impotent. The sovereign is a recipient and source of information. He or she allocates resources to the program, which is assumed to be just one of several among which allocation choices must be made. Because of the nature of the university, however, the sovereign actually *directly* controls (can alter each year) only a small fraction of the total resources available to the program.

The sovereign also communicates with the program, sending and receiving messages and making decisions on resource allocation and on other matters based on the information from the feedback loop and information communicated from the program. Even when the sovereign is "making a speech," that act may establish or change expectations for programs (or subsovereigns) who in turn allocate resources. Thus the role of the sovereign includes a measure of direct allocation of resources and a measure of influence on the way each program uses its resources.

The Program

The box entitled program is both ambiguous and complex. It is ambiguous because, as was pointed out earlier, the organizational and programmatic structures of a university are not congruent. It is complex because it generally represents several people and, in addition, in the two dimensional representation of Figure 2, it must stand for both hierarchical and collegial aspects.

Communication

The cybernetic model used in this paper accounts for two of the important communication processes in the administration of a university: (1) the two-way transmission of information, written and/or verbal, formal or informal, between the sovereign and the program, and (2) the communication represented by the official feedback network of the organization which provides information to the sovereign and to the program.

Direct communication between the sovereign and the program is represented in the model by the two-way arrow connecting the boxes. Information reaching the sovereign and the program through the university's information system is represented in the model by the arrows entering the two boxes from above. It must be recognized, in addition, that communication does not always follow official channels and that the situation affects communication--a message received in one set of circumstances may lead to entirely different results than the same message in different circumstances.

Outcome Proxies

Because all of the official intramural information in the feedback loop proceeds from the box entitled "Outcome Proxies," it should be noted at the outset that this term does not refer solely to performance measures or even solely to information at the output end of the system. The term "Outcome Proxies" includes any official information which one of the actors may regard as a measure of quality or value pertinent to the program's activities. Thus it may include (1) input information, for example, quality of incoming students attracted to the program; as well as (2) activity measures, which may or may not be related to either input or output, for example, number of courses taught per term; and (3) output information whether agreed upon (as an outcome measure), or controlled upon, or not.

Both completeness and care are required in selecting and interpreting those items which will be controlled upon in the information system. All pertinent information should be included in the feedback loop. However, it should also be noted that information overload can occur. Moreover, even in the absence of overload, information introduced into the loop will influence behavior *whether or not such information was intended as a performance measure.*

Information Processing and Feedback

The box entitled "Information Processing" and the single input and output lines together represent a complex set of functions which are essential to the functioning of the model. "Information Processing" represents, first, the conversion of data into information--an essential and powerful role usually assigned to one or more persons and/or staff offices in the organization. The persons or offices responsible for this conversion process may collect data from several sources and supply information to several programs and/or to several sovereigns. The way in which information is organized and presented influences behavior, whether or not that is the intention. It is particularly for the foregoing reason that staff roles have become increasingly essential and influential in recent years. The archaic belief that "line" positions are intrinsically more powerful than "staff" positions is subject to significant challenge in those instances in which the staff role includes control of information.

The "Information Processing" can be a person (or persons) who switch(es) data to a program and/or sovereign or into a process by which the data becomes part of an information system. Even the subsovereign who opens and routes the president's mail can serve as an important force in the operation of the system by virtue of choices made.

"Information Processing" also includes temporal concepts such as timeliness and frequency of reporting, time lag between an event and the decision cycle, and compatibility in the time domain of various data bases or sets of information. The system cannot respond to information instantaneously and some of the temporal characteristics reside in information processing. Others are features of the sovereign or program or of the activities in which the program engages.

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Only a single line is shown leaving the "Information Processing" box indicating that the *same* information is supplied to both sovereign and program. This may or may not be true. If the sovereign and program receive information which is different in either content or completeness, effectiveness of the subsystem will be reduced if only because mistrust impedes communication and cooperation between sovereign and program.

Extramural Information and Noise

Signals also enter the feedback loop from sources outside the subsystem. I distinguish between *extramural information*, by which I mean organized and verifiable signals from outside the organization, and *noise*, by which I mean random signals or disconnected data from outside the organization which distract the parties from attention to the genuine intra- or extramural information.

Extramural information originates from various sources in the environment in which the organization functions, such as the profession (with which the program is associated), or the broader learning community. Such information may signal stability or monotonic change, or fluctuations in various parameters, or value shifts or societal trends. The annual AAUP salary survey provides an excellent example of extramural information which influenced behavior in many universities for several years.

My definition of noise includes only disorganized signals, whether they be akin to static or to the raucous din of a rock band, which break the concentration of persons in the system or drown out information being transmitted through regular channels.

Although it is not shown explicitly in the diagrams, noise can also influence the communication link between the sovereign and program.

Multiple Sovereigns

Thus far the model described has assumed that each program is related to a single sovereign and draws its resources from a single source. Such is not always the case, and when multiple sovereigns are included (Figure 3) the functioning of the system might be expected to change.

If there are two sovereigns allocating resources within the institution, and if they act independently, the program will often be relieved of the need to make internal allocation choices between the activities supported by the two sovereigns. Let us assume, as an example, that sovereign 1 is a dean allocating resources for personnel to support usual instructional, research, and service activities. Let us assume that sovereign 2 in the example is the director of a computer center who allocates resources (central processor time, terminals, etc.) in support of computer-assisted instruction. If the sovereigns do not function congruently, the program may be in a position to choose computer-assisted instruction in place of instruction by faculty *without facing a decision concerning whether learning will be equally good or better.* Here the computer represents an independent free good. There will be a natural tendency for the program to seek to increase its total resources. Both effectiveness and efficiency may suffer when independent multiple sovereigns exist within an organization. Multiple sovereigns within an organization need not represent a dysfunctional situation, however, if there is effective coordination between sovereigns.

The second sovereign may also be external to the organization. Federal agencies funding the research of individual faculty members represent an excellent example. This, too, can be a beneficial situation or, in some circumstances dysfunctional. Dysfunction most often occurs when the ex-

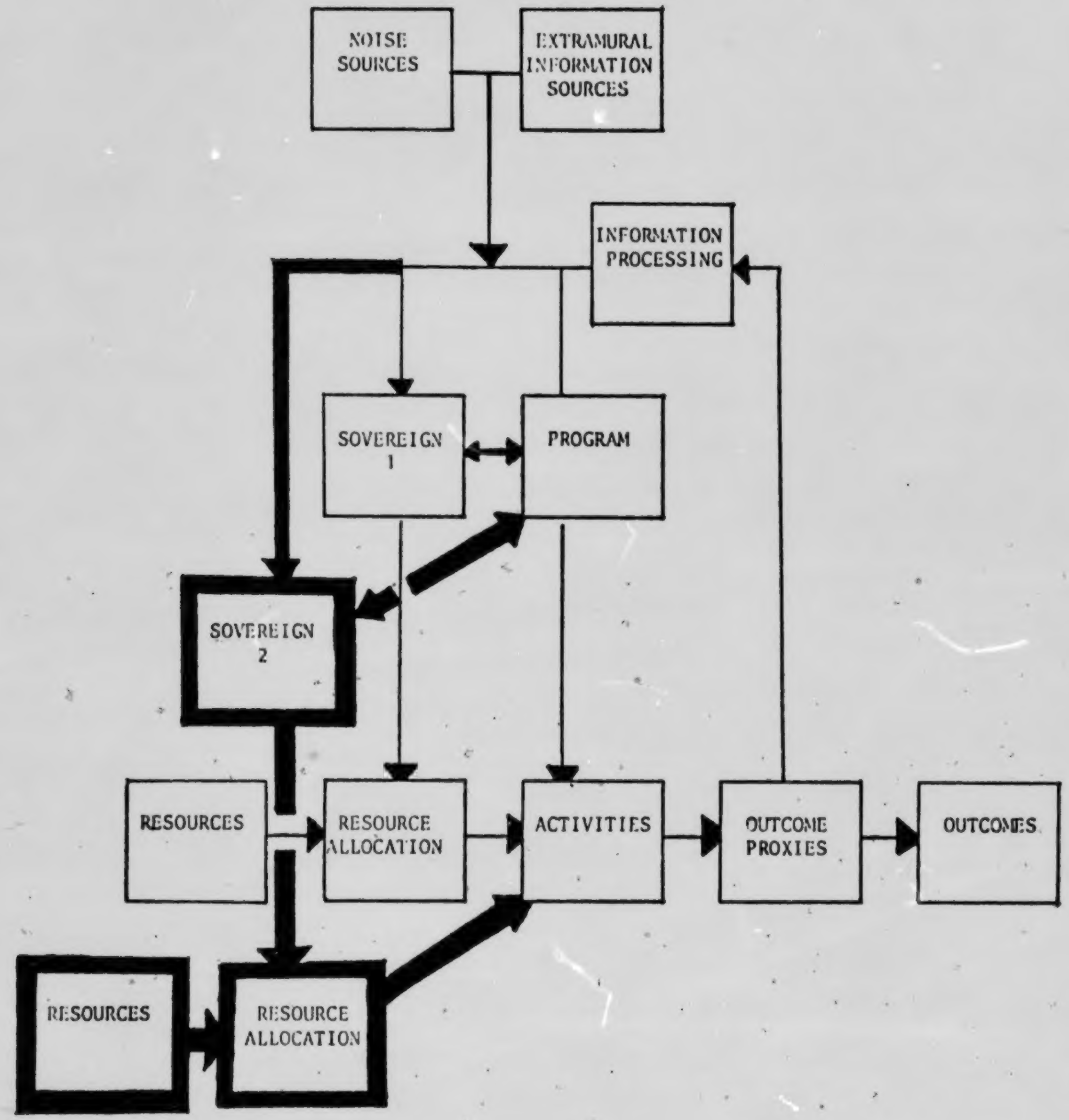

Figure 3. The cybernetic model may be extended to instances in which more than one sovereign (in this case, two sources of budgetary authority) is related to a single program. Not illustrated is a potential communication link between the sovereigns.

tramural tail begins to wag the dog, e.g., when the level of an externally-funded activity exceeds the appropriate scale for the needs and goals of the institution.

Structural Factors and Other Initial Conditions

The foregoing sections have focused on the individual program and its sovereign or sovereigns, activities, information sources, etc. There is yet another dimension of complexity which stems from the fact that each sovereign usually relates to several programs. This at once raises issues of "span of control," of the extent to which communication and influence can be maintained when the individual sovereign is responsible for a number of programs differing in size, complexity, and structure, and of the communication linkages between programs--which a good sovereign will usually wish to foster.

When the arrows are reversed and the model begins to operate, the results are, in addition, dependent upon certain *initial conditions.* These include (1) the initial values of a number of variables which might be caricatured in language like "position," "velocity," "trajectory," "morale," "prevailing internal and external environment," etc., and (2) the history of behavior and relationships within the institution. The sovereign's strategy, the design and use of information, and the resulting behavior of the program(s) will depend strongly on these initial conditions, i.e., on the prevailing situation.

III. Principles for the Design and Use of Information Systems

It is now time to assert a small number of principles which can assist the university administrator to play a more effective role. The following set is divided into four parts respecting the somewhat arbitrary categories of *data*, the *derivation* (from data) *and presentation of information* (as distinct from data), the *development of the* (information and decision) *system*, and the *use of information in decisions*. The list can no doubt be expanded but, together with the earlier discussion, should provide a reasonable starting point for improving the design and use of information systems.

DATA

1. Each data element must be defined at the outset in ways which will be acceptable to administrators (at all levels) and faculty and these definitions must be fully known to all actors. (This involves identification of each element and definition, with the help of users, at the lowest level which can be cost justified.)
2. Data element definitions must be unambiguous and clearly state not only the source of the data, but also time of collection, frequency of updating, level(s) of aggregation, and accuracy.
3. Data must be based on sources which can be traced to individual transactions, which are sufficiently reliable that the entire data base will have credibility. That is, unless errors are rare, data will be rejected by those involved in decisions.
4. Data must be based on sources which are viewed as official, i.e., on recognized official records when such exist.
5. Data must be preserved at the transactional level for a period of time equivalent to the expected period of use of the information which is derived from it.
6. When more than one data base is involved, definitions must be compatible, and the scope of aggregation and the time of collection must be equivalent so that linkages between data bases can be used to deduce valid information.

7. Some common data elements must exist in each linked data base to facilitate connections.

DERIVATION AND PRESENTATION OF INFORMATION

8. Keep it clear and simple. Information can be distinguished from data (facts derivable from individual direct observation) by the level of organization (ordinarily higher), clarity of presentation, appropriateness to a decision process, and by the omission of extraneous facts. While the boundary between data and information is fuzzy, the term information, as used here, implies the creative intervention of human intelligence in the aggregation and organization of data and an intent to communicate.

9. The derivation of information from data usually depends upon the ability to link data bases logically and reliably; the credibility of the information so derived will always be less than or equal to the credibility of the weaker (weakest) data base.

10. In presenting information, the relation to the basic data must be clearly stated and the mixing of information derived from different data sources should be avoided. (Simply stated, it must be recognized that there are apples and oranges so that invalid comparisons will not occur.)

11. In presenting information, display as little as is possible for the purpose intended in order to decrease the danger of information overload.

12. When possible and efficient to do so, valid extramural information should be made part of the official internal information system so that everyone will understand the environment in which the institution operates (i.e., constraints, conditions, societal trends, value shifts).

13. The presentation of information should provide acknowledgment of both accuracy (a measure of freedom from systematic error) and precision (a measure of random error [e.g., due to size of sample] and of the potential effect of fluctuation phenomena).

14. The official organizational communication system should present the *same* information to each sovereign and program. Moreover, *all* information should be available to all subsovereigns and programs and to faculty (respecting the importance of collegial processes).

DEVELOPMENT OF THE SYSTEM

15. In designing an information system, full account must be taken of the activities to be described, of the structure of the organization, of

the decision makers, of the nature of communication, and of the institution's decision processes.

16. In order to maximize effectiveness, development of an information system may also require alteration of the structure of the organization or of the institution's decision processes.

17. The design of the information system must recognize that effective communication involves both information *and* the situation. Hence, the appropriate information for a particular decision will also depend on the institution's environment, on its history and current situation.

18. The design of the information system should provide for further expansion and development (particularly as deficiencies are discovered and as learning takes place) but such development should not block comparison with information from an earlier period.

19. There is an important role for organizational development in building the skill of sovereigns and subsovereigns in understanding information and in translating information into wise decisions.

USE OF INFORMATION IN DECISIONS

20. *Official* information should include (be based on) a spectrum of performance measures (outcome proxies) which is sufficiently rich to support goals but not so extensive as to confuse. These performance measures should be presented and used in such a way as to foster cooperation between units, integration of organizational structure and program structure, and of hierarchical and collegial processes, and of group and individual goals.

21. Since, strictly speaking, only individuals can have goals, it is a leadership responsibility to build goal congruence (or, some would say, to accurately reflect the goals of the dominant coalition) through the prudent use of communication (information).

22. Timely and effective information will reduce the influence of informal information (e.g., the grapevine) on behavior and decisions.

23. It is probable that the institution's environment will change over time, necessitating changes in goals, activities, etc., and therefore changes in information and decision processes. A firm base of data definitions will, however, ease such transitions as well as those required by the differing styles of new sovereigns.

24. Information for decisions should provide for the identification and evaluation of alternative courses of action.

25. When a decision becomes politicized, the information system will play a diminished or altered role until the issue is once again returned to the official hierarchical or collegial channels.

IV. Coda

While it is good and virtuous to seek ways of improving the design and use of information systems, it is sobering to recognize that the improvements which can be effected by such activity, while significant, do not come easily or quickly. Such efforts are aimed at reducing uncertainty and helping the institution to improve by fostering understanding and constructive response to changing conditions. There may be circumstances in which changes in the information and decision processes will be hard pressed to keep up with the pace of change in the environment. Situations may also arise in which the institution's well being will depend on its ability to reallocate resources quickly. In either case, the key to successful response will rest on the skill and good will of the people involved. For example, while an information system can be useful in identifying slack resources, it will ordinarily require consummate leadership skill to redirect them on short order.

Much of this paper has been based on the assumption that hierarchical and collegial decision processes are basically sound and operative most of the time. Even though their metastability has been recognized, there has been a tacit assumption that political considerations dominate only infrequently. Many institutions are experiencing or facing a period of scarcity which may alter that assumption. If rationality and authority are regularly replaced by conflict, the role and importance of the information system cannot be expected to remain unchanged. Further experience, study and skill will be needed to model these situations and to establish the precise role to be played by information systems. Even under such conditions, however, it is likely that major portions of an institution's operation will be free from conflict and that the principles described in this paper will at least apply to that subset.

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LET'S STOP BLAMING MIS
(. . . AND MANAGE)

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During the past year, the State University System of Florida undertook an extensive study designed to develop a long-range plan to address the traditional problems cited concerning Management Information Systems. Although the MIS Office had a representative on the study team, the remaining twelve members were university and central office staff with other areas of expertise. This paper describes the methodology employed and the ensuing results.

The methodology used in this project is unique due to the scope and the involvement of not only a system of nine universities but also the external environment. Furthermore, the initial assumption that the problems centered around the technical elements was found to be invalid. The majority of the University System information troubles did not reside in software and hardware applications but in general management practices. This presentation will explore these surprising results and identify several essential requirements necessary to avoid the same pitfalls in Management Information System planning. This paper should be of interest to both data processing persons and general administrators.

Theoretical Implications

Since the genesis of man, the practice of management has existed, but only in this century, has it materialized as a viable theory worthy of consideration and study by practitioners. However, due to the technical and social nature of organizations, management theory has not remained static, but has been swept up in the throes of change since its inception. This dynamic nature inevitably has resulted in many lasting innovations, but of them all, the application of systems thinking to management has had the most profound impact. Essentially, the systems approach embodies a philosophy that is based on the recognition of all organizations not only as interrelated subsystems but also as a part of complex suprasystems. A biologist, Ludwig von Bertalanffy, was responsible for the principal thrust of systems theory when he introduced openness to the environment as a means of distinguishing living organisms from inaminate objects.[1] This singular observation, made over twenty years ago, resulted in a revolution in management thought.

According to von Bertalanffy, all living entities survive by importing into themselves certain resources from the environment, transforming these in accordance with their own system characteristics, and exporting other types of resources which result from the transformation process back into the environment. Through this process, an organism obtains the resources necessary to prevent entrophy and eventual death; therefore, the exchanges between a living entity and its environment assume a critical significance in survival.[2] Moreover, this conceptualization is an accurate description of both living animals and organizations; hence, as von Bertalanffy's work was accepted, the view of organizations changed radically from that of closed to one of open systems. Since the environment not only supplied the organization with resources but also consumed them, it became a major variable in management theory.

Concurrently, as management theory underwent a metamorphosis, the environments in which organizations exist were evolving also. What once was an agrarian society now consists of an environment which can be described best as turbulent. Today, managers are beset by sudden shifts in social attitudes and norms, rapid changes in technology, political linkings of large, powerful organizations, a plethora of governmental regulations, pluralistic demands, an unstable economy, to name a few. Furthermore, these are only the vanguard of the extant contingencies in present environments. For instance, institutions of higher education are facing unparalled conditions of declining enrollments and changing student mixes, increased competition for scarce resources, unionism, and more and more demands for accountability.

To meet such adverse conditions, biological systems survive by discovering and performing according to the contingencies in their respective environments.[3] The same is true of organizations. They must monitor the relevant and potentially relevant environments and adapt to the changes accordingly. This function is paramount when turbulence is present, for sudden, adverse changes that affect the input-output exchanges of an organization can lead to death if adaptation is not timely. Survival, then hinges on the ability of an organization to process information. As environments have increased in complexity and change has become more rapid, organizations have had to develop the capability to cope with the resulting uncertainty and still facilitate decision-making. Due to timely advancements in computer technology, Management Information Systems (MIS) became the most expedient alternative capable of fulfilling the dire need for information-processing.[4] Consequently, the concept of MIS mushroomed throughout most types of public and private organizations as the solution for any and all problems.

Description of the University System of Florida

The previous discussion reflects several theoretical truths that can be applied to all organizations. By definition, the State University System of Florida (SUS) is indicative of this application, for it exemplifies the interrelationship existing among the various environmental components - social, economic, government - and the ensuing effect on adaptability and survival. To illustrate, less than ten years ago, the University System was involved in a major expansion from five institutions to nine. Concurrently, enrollment expanded from approximately 44,000 to 118,000 students. But due to demographic and economic changes, recent developments are reflective of a nationwide reversal of this earlier trend. In a relatively short period of time, the educational atmosphere in Florida changed from one of acquiring resources for growth to one of managing scarce resources. As a by-product, state legislators and administrators increased demands for accountability, thereby, putting higher education on the defensive. Consequently, this augmented the need for coordination system-wide and placed additional emphasis on information-processing. A pervasive Management Information System inevitably became the answer to the dilemma.

The Board of Regents (BOR) is the single governing entity for the publicly supported universities in the state of Florida. To accomplish its statutory function, a central office exists which basically coordinates the activities of the universities and monitors compliance with established policy; accordingly, the responsibility for system-wide collection and reporting of data is at the central office level. This is accomplished through the Management Information System which operates using data tapes collected from each university. Actually, the sudden changes in the educational environment left the SUS in a crisis management mode of operation in which little time existed for planning, especially in the area of information systems; therefore, systems were designed to solve immediate problems. This immediacy resulted in gradual centralization of the information and reporting function. Normally, any change in an organization has the potential to generate discord, but when coupled with suddenness and an explosive environment, this possibility intensifies. The SUS was no exeption to this, for as the movement towards centralizaiton occurred, a myriad of problems developed. Eventually most were solved, but hardly to the satisfaction of all. Not unexpectedly, the aftermath of this situation was the growth systemwide of the belief that the existing data systems were too fragmented and complex to be useful and hence, were to blame for any and all problems in the University System.

When investigating the historical development of Management Information Systems, the SUS application and ensuing problems appear to have evolved in much the same pattern as most other organizations. The majority originally were designed around prevalent operational needs with little regard to the requirements of top-level decision-makers. Interrelationships were disregarded and integrated data bases non-existant. This caused redundant collection of data and thereby, increased the chance of error. Data reliability and validity automatically became suspect. Since planning was not possible and needs not identified, irrelevant data often were collected in an attempt to be prepared for all contingencies.[5] Eventually, the recognition of the existence of most of these problems in the SUS lead to the implementation of a study to investigate and identify the contributing factors and recommend solutions.

Methodology

The Sus Systems Planning Study was to be based originally on the IBM Business Systems Planning (BSP) methodology; however, due to the size and complexity of the University System and the trends which developed from the interview results, the procedure was modified in accordance to situation demands. Nevertheless, the SUS study still embraced the basic tenets of "top down" determination of information needs and information support by decision-making process.

In order for a study of this scope to succeed, it is axiomatic that top management must visibly sanction it, but in a university system it is also crucial that each institution support the project. To gain this acceptance, each university was asked to provide one team member from the upper-middle administrative ranks with representatives from the BOR Central Office constituting the remaining membership. Four three-member teams were used to conduct approximately 150 interviews during a five-week period. The interviewees represented a sample of top and first-level middle line administrators in the SUS. Since one goal of the study was to enhance the relationship between important elements of the external environment and the University System, interviews were held also with legislators, their staffs, and state agency personnel.

Generally, the interviews lasted two hours and were conducted using a standard set of questions for each team. The information matrix, the major tool in the IBM methodology, was not used in this study, but the decision-making processes, which were identified beforehand by the teams, were used in the interviews to structure responses and subsequently, in the analysis to organize the results. Since BSP was used as an overall guide, much of the interview time was used to establish the administrator's position in the decision-making structure and identify specific functions of the job. The primary purpose of this information, validation of the matrix, was not realized until completion of the interviews and thereby, resulted in compilation of data that was of little value in the final analysis. The information germane to this study was those processes in which the administrator was a decision-maker and the problems which hindered his or her decision-making ability.

In order to establish the validity of the interview results, a synopsis was sent within 48 hours of the meeting to each participant for verification. Overall, the verification return rate was both slow and poor, and those which were returned provided little additional information and few corrections. Although this procedure consumed considerable time and resources and resulted in no appreciative increase in information, it contributed immeasurably to the overall credibility of the study. Knowing that the results of each interview would be scrutinized by the participant, the team members were motivated to record the events correctly and precisely, and the 48 hour deadline forced the teams to summarize the discussions immediately afterwards when still fresh in each member's memory. Moreover, many interviewees, when advised of the procedure, commented on the legitimacy that they perceived was added to the study due to the verification.

After completion of the interviews, the data was analyzed by process, by administrative position, by problems, and by frequency. From this, the team members developed a long-range plan for information systems development and problem solutions for the SUS.

The Study Findings

In retrospect, information systems have developed rapidly in response to many diverse needs; consequently, much of the development has occurred in a fragmented fashion allowing for only minimal integration of data. Moreover, such ad hoc systems have been identified in past studies as the major source of reporting problems especially when aggregation of data and consolidation of reports are required.[6] Based on these observations, when information problems proliferated throughout the University System, the solution automatically became one of planning; hence, the birth of the Systems Planning Study. The original conception involved a systemwide investigation of the existing systems which would culminate in a long-range plan for the integrated development of one comprehensive information system. Apparently, the study decision was based on the assumption that the current problems were a result of past development mistakes. This perception was prevalent throughout the system, although no prior analysis supported the contention. Yet, the study was initiated under the expectation that most problems would be technically oriented and solutions would emphasize system

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redesign.

Historically, the limiting factor in most human endeavors has been the humans, themselves. This also is true of information systems.[7] Findings from this study clearly indicated that many of the problems existing in the University System originated with poor management practices, not technical applications as expected. While system development is a critical ingredient in proper information flow, it is not a substitute for good management. When things go wrong, the current vogue is to scream "MIS"; however, it may be wise to examine first the policies, structure, and attitudes in the organization before determining the blame.

The remaining section will describe the actual study findings, and will be presented as follows:

I. Strategic Planning
    A. Data Base
    B. Legislative Request & Allocation Budget
    C. Enrollment Projections & Reporting
    D. UNIFTRAN
    E. Priority of Systems Development

II. Managerial Control
    A. Faculty Workload Data
    B. Expenditure Analysis
    C. Financial Summaries
    D. Data Administration System

III. Operational Control

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A convenient way of examining the role of management is through a decision-making hierarchy that simply divides the functions into three: strategic planning; managerial control; and operational control. Strategic planning is the very essence of the open systems model, for it involves the development of long-range plans only after consideration of the external environment, internal interests, and data base analysis of past and current performance and forecasts.[8] Actually, the initial phase of planning constitutes a situation audit in which the environment is evaluated for opportunities and threats and then results are matched to the strengths and weaknesses of the organization. After completion of the situation audit, planning continues by first defining objectives and then determining the commitment of resources and budgeting of funds.

Planning is a necessary function in all organizations; however, the need increases as turbulence in the environment intensifies. When uncertainty exists, organizations must plan for environmental contingencies in order to adapt successfully to change. With the current educational environment in such turmoil, strategic planning has become an important tool in higher education; however, this increasing importance has brought additional problems. The abrupt change from a relative stable environment to one so volatile has left colleges and universities without the proper knowledge and mechanisms necessary for good strategic planning. Consequently, the results of the Systems Planning Study showed quite predictably that most problems in the SUS involved this function of management. Although most university administrators acknowledged the need for long-range planning, many were at a loss as to how to go about it especially in light of legislative instability. Also, no data base exists in the SUS which can provide information about the external environment such as manpower needs or population trends.

Being part of the state suprasystem, the State University System must constantly monitor the exchanges between this environment. One of the most crucial elements lies in the area of budgeting since this is the source of the resources for survival. The study, however, found that great confusion existed in the minds of both external and internal decision-makers as to how the Legislative Request and Allocation phases were conducted in the SUS. Since Request and Allocation Budget processes were not documented, they were subjected to frequent changes and therefore, misinterpretations. On the other hand, the Operating Budget process is part of a standard practice and software for its execution. There were few complaints regarding that area.

Enrollment projections and reporting are essential components of planning in the SUS, and whenever problems with enrollment data develop the blame is traditionally placed on MIS. The study results did not confirm this however. Actually, the lack of timely enrollment data was identified as a policy problem which no MIS in existence could solve. Furthermore, projection problems centered around a misunderstanding of the process due to the lack of documented procedures.

For a number of years, the BOR Central Office has had the responsibility to develop and maintain the Uniform Transaction System (UNIFTRAN) to be implemented by each university to satisfy operational needs but also to provide tha data required by the MIS. To accomplish this, UNIFTRAN was divided into three projects: Fiscal; Payroll/Personnel/ and Budgeting (PPB), and Academic. These projects were housed in separate geographic locations. Of all the problem areas in the Sytem, UNIFTRAN has been the greatest. The universities have resented this centralized development effort, and have not been satisfied with the results. Consequently, the study team expected to find the UNIFTRAN products inferior and dissatisfactory. On the contrary, the interview findings indicated that quality was not the issue but the length of time for both systems development and enhancement. Quite simply, the universities could not get enough fast enough. Also, the need for more user input to developments was determined. These obviously were not technical problems, but can be traced to the original UNIFTRAN plan. Geographic dispersion created coordination problems between the projects and ruled out the value of joint effort. Currently, two of the three projects have been merged and a coordinator's position has been established.

Since the study began as a project to identify system development priorities, the team investigated the current efforts in that direction. System priorities are established now by Steering Committees consisting of university Vice-

Presidents. Comparison of the interview results and the Steering Committee's system development schedule showed consensus. The need for a Financial Aid System has top priority throughout the System with a Contract and Grants Administrative System, Auxiliary Services System, and Student Fee Collection System following in importance.

Planning is not a separate process but is interrelated with other management functions; one being managerial control. It is difficult to tell where planning ends and managerial control begins, for the latter is that activity which insures that actual events conform to plans. Very simply, it is the comparison of standards against actual performance and is essential in evaluating the planning process. Good managerial control is of particular significance in the current education environment of scarce resources and increased demands for accountability. Because of this, problems involving the managerial control functions were regarded as critical by SUS administrators. One example is faculty workload data. In the SUS, this data is collected from the universities in the form of an Academic Assigned Activity File; therefore, all problems are blamed on the collection mechanism. Unfortunately, the evidence does not suggest such a simple solution, for the study finding indicated that the problem stemmed from the lack of an agreed upon definition of faculty workload. Consequently, some universities submit faculty assignment while others report faculty activity. This leads to inconsistent data and loss of credibility. Obviously, system redesign is not the answer but a policy is needed. Since the Academic Assigned Activity File is the basis for the SUS Expenditure Analysis, this policy issue is even more important. The Expenditure Analysis could be a valuable tool used in control but presently its validity is questionable.

One important component of managerial control is the use of good financial data. The accounting system developed by UNIFTRAN has been successful in providing this necessary information on the operational level;, however, top level administrators complain that summarized data is often inadequate or too detailed for their purposes. The tendency is to blame UNIFTRAN for not meeting their management needs. Investigations into the problem found that most of the requested reports were available, but it was an option of the university whether to run them.

To insure good mangerial control, information must be accurate and current, but collection should create no unnecessary work; therefore, if the data is stored centrally, that source should be used without the use of additional requests. To facilitate data collection and reporting, the SUS has implemented Data Administration System in which all requests for data are channeled through one point on the university campus and the BOR Central Office. This structure provides a screening mechanism which eliminates redundant requests. Similarly, the Date Committee screens all requests for permanent addition of new elements to the data tapes. The study found both of these procedures working effectively and enhancing the managerial control function.

The study finding showed the least amount of difficulty in the area of operational control. This management function involves the monitoring of operations to assure that procedures are being carried out as planned. The essentials are communication and feedback. While the University System used interinstitutional councils and committees as a major means of communication, some problems do exist. Most communication problems seem to be caused by blockages within the organizations themselves. For instance, poor information flow between the Acedemic and Administrative areas of the universities or the BOR Central Office. This results in inconsistent information reporting and redundant requests that are so often blamed solely on MIS.

Conclusion

This paper has taken an open systems approach to explain the results of a major study conducted in the State University Sytem of Florida. The educational environment changed drastically in a very short period of time, and this change created the need for greater information-processing. The growth of Management Information Systems resulted, along with the problems that occur from rapid expansion. The SUS Systems Planning Study was an attempt to investigate these problems and develop a more orderly approach to information systems development. The study was based on the premise that technical design was at fault; however, the findings did not support this. Most problems were a result of poor management practice. Since the environment in which the SUS exists today is so turbulent, planning and control have become essential to survival; therefore, these functions stood out as problem areas by nature of their very criticalness. Although it is the vogue to blame MIS for all problems, other institutions of higher learning should take heed from these results. Before initiating expensive system redesign in search of that one big comprehensive MIS in the sky, it may be wise to first examine management practices and evaluate their effect on information systems instead of the other way around.

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PRIVACY AND DATA PROCESSING
IN HIGHER EDUCATION

by

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Abstract

The concern for privacy of student data is increasing both at the state and federal level. Laws have been legislated and others are currently being enacted. Even the common denominator of legislation indicate that it will have a considerable affect on both EDP personnel as well as non-EDP management in higher education. These possible affects are the subject of this paper.

EDP personnel are affected in that they will have to design their systems and data bases differently providing not only more information, better security, more completeness, higher accuracy, but also for greater flexibility. Some approaches to these problems are discussed.

Non-EDP management are affected partly because they are ultimately responsible for the implementation of the legal provisions and partly because they are involved administratively in the process of inquiry, challenge and dissent. And they need additional information in this process that EDP must provide.

There is a cost for the implementation of privacy regulations. It will require additional storage equipment and extra processing. But the main additional cost is personnel cost, both EDP and non-EDP cost. The magnitude of this cost is partly a function of environment factors such as the number inquiries and challenges and partly on contrl variables such as the policies on the nature and content of information provided. A similation model can calculate the costs for each required procedures. The consequences of each strategy include personnel time (EDP and non-EDP), as well as storage and

and computer time for both one-time and running cost components.

General conclusions on the nature of the cost function will be presented as well as empirical data on the costs as calculated for one university given a set of policy and control variables.

Laws on Privacy

Concern for privacy of data was largely triggered by the cause celebre case of a proposal for a National Data Center to centralize personal information processing for the federal government. This raised the specter of the Orwellian big brother watching over each individual with integrated access to records including academic records from schools and universities. The literature on the subject included books by Vance Packard (Packard 1964), Alan Westin (Westin 1967, 1971, 1972), Miller (Miller 1971), and James Rule (Rule 1974), and a survey in 1974, which identified significant research ongoing in the private sector in 24 organizations (nine of them are universities) (Davis 1975). There were, of course, numerous government studies and these culminated in the Privacy Act of 1974. (U.S. Congress 1974).

There are also many states that have their own privacy laws (Demitriades, 1976, p. 26) and in some towns, such as Berkeley, California, there are local privacy laws (Hoffman, 1974, p. 4). As for international laws, there are none, though there is considerable interest in the Council of Europe and the OECD (Niblett, 1971).

The 1974 Privacy Act was confined to the federal sector, with a Commission appointed to study the extension of the law to the private sector. Meanwhile, also in 1974, the FERPA (Family Educational Rights and Privacy Act) was signed into law (P.L. 93-508) (U.S. Congress 1974). This law specifies requirements concerning record keeping systems of institutions of post-secondary education. The important requirements included the student's and the parents' right to inspect, review and request amendment of educational records on the student; [20 USC 1232 of (a)(i) and (2)]; obligation on the part of the institution to inspect and review the records within 45 days of the request to access [20 USC 1232 of (a) (i) A]; hearings of a challenge of records that may be misleading, inaccurate or otherwise a violation of privacy right, as well as an insertion of the student's or parents' written explanation of any dispute in the student's record [20 USC 1232 of (a) (2)]; control of student and parent over directory information [20 USC 1232 of (a) (5)]; and an obligation of the institution to account for all disclosures requested or obtained about the student.

FERPA could no longer be ignored by post-secondary institutions because it provided for the termination of federal funding if there was a lack of voluntary compliance. Monitoring of the compliance was made the responsibility of the Department of Health, Education and Welfare [20 USC 1232 of (g)]. DHEW issued FERPA regulations in June 1976, relying heavily on self-regulation and left to each institution most of the responsibility for defining the necessary policies and detailed procedures.

Institutions implemented the FERPA and the DHEW regulations but with varying interpretations. The uncertainty of interpretations was furthered by the bill HR1984 introduced in the 94th Congress by Representatives Koch and Goldwater to extend the Privacy Act of 1974 to the state, local and private sectors including education. The 1974 Privacy Act had created a Personal Privacy Protection Study Commission (referred to henceforth as the "Commission") which included Representatives Koch and Goldwater. This Commission held hearings on the 1974 bill and published a report in June 1977 with a special chapter on "Record Keeping in the Educational Relationship" (Commission, 1977: 393-444). This includes 15 recommendations, five of them amending or extending the 1974 Privacy Act.

Given the above provisions relating to privacy, one should ask the question as to the costs of implementation for a university. To answer this question, one should first examine what needs to be done to protect privacy, and what are the possible responses and strategies for management in a university.

Manager's Response to Privacy Rights

There are some measures that a manager can take to respond to the threat to personal privacy. Part of these are technical and are the prime responsibility of EDP personnel. Others are the responsibility of non-EDP personnel. Each of these will be examined. First, the responsibilities of EDP management:

1. Examine carefully the data base for data that is not necessary. Very often there is data that is no longer necessary or that was kept merely because it is "nice to have". Purging such data will not only reduce danger of an invasion of privacy rights, but will reduce the information glut we now have and also reduce the cost of operating the information center.

2. Improve the security of data. In this context, security can be defined "as the means and procedures of ensuring that privacy decisions are in fact enforceable and enforced. This may require a technology that is sufficiently rugged to resist determined attack and sufficiently economical to encourage its use" (Conway _et al_., 1972, p. 211). Many computer systems of today were designed before our concern for privacy and, therefore, are not equipped for this task. But once the legislation regarding privacy is enacted, for the private sector, the manufacturers will most likely respond to the need of adequate equipment.

3. Special programs need to be written to inform data subjects of the data available on them (i.e., record existence notices) to generate consent letters for uses of data other than originally intended, as well as programs to retrieve data on any individual data subject. The retrieval capability at the record level could imply random access devices if responses to needs for information by data subject were to be fast and timely.

4. Design and implement reports that provide information necessary for agement to meet their responsibilities in determining violations of privacy

in each individual case that may arise where a student may exercise his right to "access". This will include display of information available in the data base on each student and how it is being used, as well as logs on the accesses made to data and by whom. Knowledge of this information is the "right" of the data subject.

5. Logs should also be kept on the number of accesses, challenges, corrections and insertions made because of privacy regulations, both federal and state regulations. This will enable computing the costs of complying with privacy regulations.

6. The data system must be checked for levels of accuracy and degree of completeness. The university is now formally responsible for having the data accurate, complete, timely and relevant.

7. The data file must be designed with variable length records so that a student disputing the validity of data may "demand" the insertion of a rebuttal. In cases where the individual strongly disagrees with the organization responsible for record-keeping on the relevance or even accuracy of the data, then the data subject can insert in his record his view or rebuttal. The exact circumstances and length of this rebuttal varies with legislation. In the case of the Family Educational Rights and Privacy Act of 1974, the data subject--in this case the student--can record up to one hundred characters of rebuttal. In cases of proven or agreed inaccuracy the data subject has the right for prompt correction and in cases of proven irrelevant data, the right of erasure of such data.

8. The linking of files may well be affected by privacy regulations. Currently, many universities use the Social Security numbers as a linking element for many of its files (student, course, alumni, ACT). The HR1984 bill prevents the use of the Social Security number for purposes unless required by statute or unless given permission by Congress. Without such a restriction it is theoretically possible to link and relate university files to those of the banking

industry, credit agencies, and mailing list companies to name just a few. These three systems alone contain over 244 million data subjects (Davis, 1974, p. 240). To prevent such an interrelationship and its possible misuse, there are many National Commission recommendations against the use of the Social Security number for non-federal uses which will then exclude the universities in spite of its many advantages.

9. Anticipate legislation for privacy (such as the inability to use the Social Security number) and have an information system designed that will meet the legislative requirements. A matter relating to design is the need of information on information, that is additional reports required to log and monitor access to sensitive data. This and other design needs can be incorporated into a new information system with little extra marginal cost. It could be very costly for a complex existing system to redesign and implement. Fortunately, however, many information systems are periodically redesigned because of changing needs of the decision maker and environment or because of new technology. If the needs of privacy rights are predicted in advance to coincide with such design changes needed anyway, then the cost of responding to privacy rights becomes marginal. The cost of privacy for new institutions with new information systems is less marginal.

This far, we have discussed mainly the responsibility of EDP management. In a sense, though, this is also the responsibility of non-EDP management, since they are ultimately responsible for EDP management. They have other specific responsibilities, which include:

1. The content of the use and dissemination of data, especially data used for purposes other than originally intended. In such cases the data subject (mostly the student but could be faculty) must give permission for further use.

This is almost a right of control that is argued to be a basic part of privacy: "the claim of individuals, groups or institutions to determine for themselves when, how and to what extent information about them is communicated to others" (Westin et al., 1973, p. 7). Furthermore, "the control of the circulation of information...[is] a power that often is essential to maintaining social relationships and personal freedom" (Miller, 1971, p. 3).

This limitation of use of data for purposes other than routine and originally stated purposes (unless the data subject gives special permission) can come to haunt and hurt the data subject, because the organization owning the data may not accept the extra effort required in getting special permission and instead may not provide the additional data. This has happened in some universities which stopped providing directory information on students names and addresses because it required getting the students' permission and as a result, both the students and the staff suffered. Also, informational needs for administration as well as students' perception of relevancy changes. Furthermore, technology also changes what information can be made available. Given these changing perceptions and capabilities, the control of the use of data becomes very difficult, unless the system is specially designed for such flexibility.

2. The student having a right of verification, access, challenge and insertion will require policies and procedures for implementing these rights. Procedures for responses must be planned, and in some cases this work can be automated. There should also be a person in each organization responsible for planning and implementing privacy-related policies. This will ensure the coordination of efforts to comply with privacy regulations.

As implied from the discussion above, some of the management responses to privacy are technical, whether this be related to equipment or to the design and operation of an information system. Much also depends on the loyalty and ethical conduct of the staff involved. But in the final analysis, the manager is responsible for protecting personal privacy. To him, the next question will be: what would it cost to implement the privacy legislation?

COSTS OF PRIVACY

There are two types of costs: a one-time developmental cost and recurring operational costs. The one-time costs include the analysis and design of procedures for personal privacy protection, and the acquisition of protection equipment and facilities. The recurring operational costs include salaries, computer time and storage costs, communication costs, and the rental and maintenance costs of security-related equipment. The main component of these operational costs is salaries, those of the clerks involved in handling the rights of notification, access, challenge, corrections, and erasures. Salaries also should include management time that will be required, along with legal advice in the resolving of challenges and in monitoring the procedures and standards for privacy protection. These operational costs will, however, vary over time: a peak soon after the privacy rights are first exercised and then leveling off at a lower level of demand for access and challenges.

Privacy costs have been estimated by various sources. An estimate of costs for implementing the 1974 Privacy Act has been estimated to be between \$.29 and \$4.97 per data subject (Goldstein, 1975, p. 67). An estimate for the private sector and for operational costs only was between \$.15 and \$3.93 per transaction (Goldstein & Nolan, 1975, p. 66). For the university sector, a simulation model developed by the author (an adaptation of the Goldstein model) computed the costs for a full time equivalent student as \$3.07 for development and \$2.54 as operational costs. This was for a small-sized university in the U.S., and the model has not yet been tested for a larger sample of institutions.

The model being a simulation model enables the computation of consequences of different policies and environmental parameters.

An overview of the model is shown in **Figure** 1.

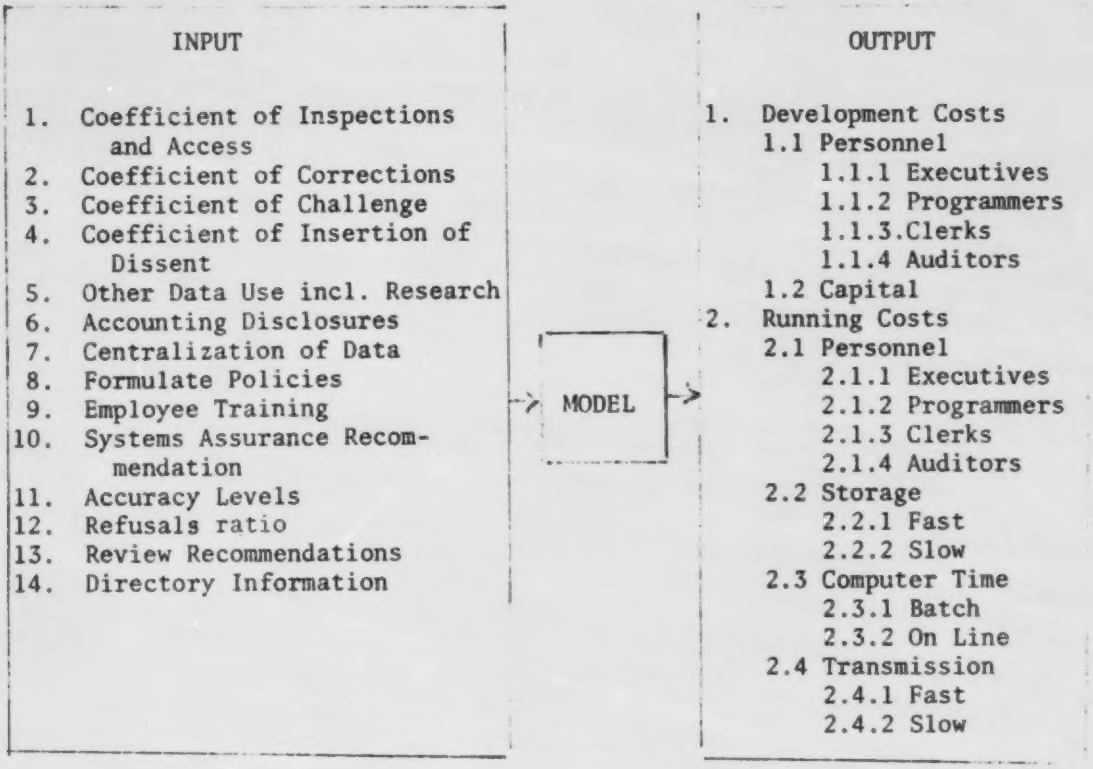

Fig. 1. Overview of Model

In it, the input box on the left shows the different FERPA and DHEW regulations, the Recommendations of the Commission, and different management strategies. Implementation of one or more of these will have cost consequences. The cost components calculated by the model are shown in the output box, right hand side of Fig. 1. These cost components can be analyzed for sensitivity for selected inputs and also used for calculating unit costs per student for different sets of inputs.

The model simulates the cost consequences of implementing existing or recommended regulations relating to privacy of students. Its design is flexible enough to simulate other proposed regulations by DHEW or the extension to the non-post-secondary sector for use by statewide agencies interested in the comprehensive cost of implementation in an array of institutions in their state

In 1976 there were 7 states with privacy legislation as it relates to the education sector (Ruff and Gottschall, 1976: 47), and 33 states have Executive Orders on Privacy (Haden, 1977: 127). This number will undoubtedly increase. Many may well be interested in a statewide simulation of their state privacy regulations.

Finally, the model can be helpful in that it will formally structure the problem by identifying the variables and the existing relationships. This information will enable institutions to plan and design their data bases, a process that has a high cost and a long gestation period. Simulations of the model will also indicate the sensitivity of unit cost/student to the size of the institution, level of instruction, and to some measure of the existing degree of data base sophistication. It may also identify the non-cost implications such as the decrease of information available to students and parents and the magnitude of challenges to existing information and reviews.

The cost estimates computed by the simulation model will vary over a range. The reasons are threefold. One is that there is a choice of implementation strategies, such as to provide information after getting written consent from each data subject for a specific application or merely to discontinue (or not initiate) that application. The second factor causing variation in cost estimates is the fact that there are a number of important cost variables that must be estimated. One example is the number of accesses, updating and challenges that will be made. In the case of the Fair Credit Reporting Act in the U.S., one credit corporation had an increase in its number of access requests by a factor of 2000. What would be the increase-factor in universities? We do not yet know. We can estimate, and different estimates will give a wide variation in cost estimates. The third difficulty in calculating privacy costs is the fact that it is too closely related to costs of security and does not enable isolating the two costs. Security is often required with or without privacy. The cost of adding privacy protection is finite and substantial and will vary with the rules of allocation used to allocate the total cost separately to security and to privacy.

We should now address the question: is this cost worthwhile? The privacy proponents will draw analogies such as the cost of privacy in telephone systems. In the U.S., over 15% of telephones are private and have unlisted numbers at a cost of $135 million annually. In a university, when an official goes on business he pays for a single room instead of sharing with a stranger. He and the university, because of him, are paying for privacy. Why shouldn't the university also pay for the privacy of students? Fortunately, the manager in most cases does not have to answer this question. He has no choice. He must pay for personal privacy because that is a demand of our contemporary democratic society, and in many cases the law obliges him to respect this privacy.

The university will be monitored for compliance of laws relating to privacy. The HR1984 has proposed a 5-member board with the right to inspect any data processing facility. Also, there is a bill currently in the U.S. legislature to set up a Federal Information Practices Board of 5 fulltime members to be appointed by the President and approved by the Senate. It is to review and report on information practices and their impact on individual privacy. The Board does not, however, have any enforcement powers.

Summary and Conclusions

The problem of personal privacy will not go away with time. On the contrary, the dangers to personal privacy will increase with time, and improving technology. With higher performance cost ratios of computers, cheaper storage devices and the glass fibres that enable cheaper data transfer, there is a greater threat to personal privacy. This is well recognized by both students and their parents. They are also becoming more conscious of their "rights" to privacy. These include the right of notification, the right of access, the right to challenge, the right for prompt correction, the right of erasure, the right of redress, and the right of control. With these rights, the students, nor the parents will accept future information systems that do not show serious concern for personal privacy and have adequate safeguards against intrusion into personal and sensitive data.

Students and parents are increasingly assertive that all personal student sensitive data not be used for purposes other than originally stated without their permission and that all data used for decisions be complete, accurate and up-to-date. Also, they insist on being informed periodically of the existence of data on them and that there be legal procedures for inspection, correction, erasure, appeals and monitoring.

Implementing the above safeguards in universities will involve a cost--both the cost of additional information and an administrative cost in time and effort. There will be a loss in efficiency and perhaps even in effectiveness as some data will be slow in retrieval and some data not retrievable at all. But this is perhaps necessary if we are to safeguard personal privacy and prevent other potentially harmful social effects. Society seems prepared to make this trade-off and privacy laws enacted in the governmental sector will be extended to the private sector and the universities.

Whatever the speed of response, universities that use computers for most of their information handling face the problem of personal privacy. Management in such universities must examine their internal practices for inconsistencies with privacy-related laws. They must respond to laws relating to privacy. If they plan their information systems so that changes required by privacy laws coincide with changes required for internal and external reasons, then the development cost of response will be marginal. As for recurring costs there are some choices among alternative strategies. But these choices must be made by management within the limits set by law relating to privacy. Violating the laws may mean fine or imprisonment or both.

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COMPETENCY-BASED JOB DESCRIPTIONS FOR PROGRAMMERS

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Traditional job descriptions cause problems within the programming environment. The "programmer" job family is usually described in subjective and abstract terms, with excessive emphasis on years of experience as a measure of capability. For the employer, such descriptions fail to encourage skill improvement; for the employee, such descriptions fail to indicate clear career paths.

To overcome these deficiencies, Miami-Dade Community College has implemented a set of competency-based job descriptions for its administrative programming staff. This paper describes the methods used to adopt such a scheme and provides a discussion of its advantages and disadvantages.

COMPETENCY-BASED JOB DESCRIPTIONS
FOR PROGRAMMERS

Management is intrinsically a human activity. And yet, whenever we think of management within the data processing environment, we typically think first of hardware management, financial management, or systems management. Only secondarily do the activities involved in managing humans come into consciousness. Is this because information systems stem from mechanistic (non-human) impulses? Is it because data processing people (and their managers) are anti-social? Is it because human activities defy rational, objective analysis, the strongpoint of the systems person? Or is it simply because people management is difficult? As someone has put it, "Establishing job descriptions is harder than writing specifications for a new piece of hardware. For most organizations, it is more tedious and time-consuming to correct a salary inequity than to order a new computer."[1]

Certainly, much of the detail involved with management of people is forbiddingly difficult. Most managers are pleased to have Personnel Administration handle such detail.

Management literature has paid a certain amount of attention to the line manager's struggles with human dynamics, especially with the big issues: motivation, reward, productivity, etc. It is true that the data processing manager's role as a focal point for these big issues is still misunderstood and underestimated. However, there are many little issues which involve the manager of data processing which potentially have great leverage on his total managerial performance. One such "little issue" is the formulation and use of job descriptions. This paper describes an attempt at Miami-Dade Community College to transform inappropriate programmer job descriptions into job descriptions that could be humanly advantageous to both employer and employee. The process of change was difficult but the results have been gratifying.

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[1] Anonymous Letter, Installation Management Review, Oct. 1976, p. 2.

Troubles with
Traditional Job Descriptions

In 1976, the programming staff in the Computer Services area at Miami-Dade Community College was experiencing high turnover and low morale. Although there were several easy-to-blame problems (for instance, low pay and crowded working conditions) one of the biggest reasons was the lack of a true career path for programmers. Certainly there were job descriptions which specified a set of programming positions, with carefully-calibrated qualifications. But this framework was not working. From the standpoint of the individual programmer, he/she could not improve his/her own position by becoming more capable. From the standpoint of management, there was considerable question that the staff had or could gain the programming skills necessary for the College's business needs. Although this sounds as if there had been a management-worker breakdown in communication or confidence, fortunately, this was not the case. Rather, these views were really produced, as natural phenomena, by a conventional way of job specification.

Traditionally, job specifications for a particular job are as shown in Fig. 1.

Qualifications--

Must have bachelor's degree from an accredited institution.

Must have 3 years' experience at the Junior Programmer level.

Figure 1: Typical "Programmer" Job Qualification List

Although the kind of work that a "Programmer" does is usually found in the job description, as well, the critical elements of the job description are the qualifications. Primarily, as noted in Figure 1 above, these qualifications relate to education and to amount of experience. There are people who argue that an educational credential (a degree) is itself a poor criterion of qualification. It would seem, though, that educational institutions themselves ought to place value upon a degree by using it as a qualification. But "years of experience" fails as a proper metric for the following reasons:

1) "Years of experience" are too difficult to count. More and more frequently, part-time work must be evaluated to determine how it should be counted. The individual himself frequently counts time-in-profession most graciously, sometimes even counting full-time education as part of the "years of experience." Consider how programming work in the Army should be discounted, since such assignment, though nominally full-time, really can never be. If the job descriptions, as is assumed in

the example above, are written to require progressively more experience, the evaluator is also burdened with trying to gradate experience. ("Was this two years' experience at XYZ Co. equivalent to the two years' experience we require at the junior level?") And, finally, how can anyone evaluate related experience; for example, should experience as a computer operator be counted in the "years of experience"?

2) Differences of situation and installation can render "years of experience" meaningless. Incompatibility of equipment or language experience come first to mind. A simple test shows these to be important: of two candidates for a position, which is the programming manager in a DEC COBOL shop more likely to choose, all other characteristics being equal --Candidate A, with three years' of COBOL experience on the same DEC -10, or Candidate B, who has three years' experience writing FORTRAN programs on a Univac machine? It is only slightly more sophisticated to realize that the operating system environment could also play a part in measurement of the applicability of past experience. A shop deeply involved in virtual systems work has concerns that can hardly be of interest to other environments. Another difference in situation lies in the relationship of the programmer to related positions such as analysts, systems programmers, or operators. Smaller shops do not have the luxury of division of labor; a programmer with coding experience in a large shop can find that he hasn't learned enough of the job in a small shop for his experience to be counted the same. Most important, too, is the compatibility of applications

from one installation to the next. The scientific programmer's experience, when he moves to a business/commercial environment, may be only slightly transferable.

3) "Years of experience" may not properly account for the quality of the experience. Although perseverance is a positive trait, the fact that someone has stayed with a profession a certain number of years is not an unmixed virtue. The person who has "gained 10 years of experience by repeating one year of experience 10 times" is almost a cliché. Assuming that there is no individual variation in the kind of experience one has causes a very interesting effect; it means that the person who has continuously expanded his capabilities is no more valued than the person who is doing the same type of work over and over. In short, valuing "years of experience" as a measuring device guarantees discouragement to the most capable. The system works as a disincentive to precisely those people who should be encouraged; the curious, those willing to seek technical responsibility, those with initiative, the innovative, and the resourceful.

In addition to the difficulties which the qualifications "years of experience" poses for the organization, job specifications can be faulted on the basis of "hidden qualifications." Fortunately, there is enough heightened social awareness that "hidden qualifications" do not (at least now) mean ethnic compatibility; the law also has force in this area. But there remain some "hidden qualifications." The most insidious may be the table of organization problem.

The table of organization is a construction that assumes that there must be a pyramidal organization structure. (Each major supervises so many captains, each captain so many lieutenants, each lieutenant so many sergeants, and so on).

Too often, organizations themselves assume that there are quotas at each job level. Whether the quota is induced by line-item budgeting or whether it is a result of a feeling that an organization should not be too "top-heavy," there are powerful forces that say that movement into higher job levels must be inhibited. There is no way to deal with this other than to call it a "hidden qualification." In other words, the stated qualifications of education and experience are themselves not enough; for an individual to move from a lower classification to a higher one requires additional steps. Ordinarily, either a job slot tagged with the desired title must be open and available for the individual, or the individual has to undergo some sort of job content evaluation so that his present job slot can be named the desired title. The former case leads to a demeaning scramble when, for example, a Senior Programmer leaves and there are a half-dozen Programmers qualified for the position. In the latter case, the "table of organization" constriction generally means great difficulty in upgrading an existing job slot.

Another "hidden qualification" is visibility. A programmer has greater likelihood of job movement when he/she has completed a major project. Externally visible accomplishment is rewarded. There is nothing particularly evil about that approach; but programming skills can be so quiet that the correct person to reward may be the person who has dramatically increased his/her productivity without externally visible accomplishment. And, too, the timing of project completion may not be appropriate.

So, we find that most jobs with specific education and experience qualifications should also state as qualifications some statement such as "provided that an open position occurs for which this description is correct, and also provided that the qualifying individual has done enough noteworthy things lately to be considered for this position." *

The result of these open and hidden qualifications on the selection and placement process is capricious and highly subjective. It renders the process a competitive one and, worst of all, it tantalizes the programmer by making him qualified on paper but subject to additional, largely unspecified, selection criteria. No wonder job movement is such a touchy subject!

Competency-based Descriptions

Instead of basing job descriptions on a set of educational and time qualifications, whenever it is suitable a set of "competency-based job descriptions" could be substituted. These descriptions would specify the degree of skill necessary for a given job and

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*Often another hidden qualification is budgetary; e.g., "also provided we can afford the additional money such a change would cost," since the higher job title ordinarily means more money. The problems involved in funding salary increases which are extra-budgetary are beyond the scope of this paper. However, that problem must be solved to deal with personnel/salary relationships no matter what the job description philosophy is. In actuality, appropriate and needed salary increases must never be arbitrarily prevented by a rigid budget mechanism.

provide some means for measuring it; then the proven competency would itself be the qualification. Further, provided that no quota was set, all hidden qualifications could be eliminated. Skill and proof of proficiency would be all that was needed.

What kind of job lends itself to competency-based measurement?

1. The job content must be fairly well-defined.

2. The primary determinant of job worth must be competency in the given discipline.

3. There must be some advantage to the employer to maximize competency in the job area.

4. The skills must be readily demonstrated.

5. There should be simple and objective measurement of skills.

Programmer job positions meet all of these criteria. First of all, the job content itself is well-defined, especially nowadays. Within a given programming group, all programmers are subject to the same standards and use the same tools. Assignments differ by application areas, but the tasks involved in programming are essentially the same.

Secondly, as the discussion above of traditional job measurement supports, in the programming discipline very specific competency is of great importance to evaluation, outweighing several conventional measures such as education and broad experience. Third, as the hidden value of programming talent becomes more and more evident, the issue of programming competency becomes more and more important. Employers can ill afford to hire programmers of marginal competency, nor can they afford to not keep them trained and up-to-date technologically; to do so, not willfully, of course, produces poor response to administrative problems as well as inadequate and worsening systems to support key administrative needs.

In addition, it is helpful if there is a related "skill family" of jobs, so that competency can be measured at each step of the family. In that situation, a person can progress, by means of competency demonstration, from one step of the family to the next step. This type of movement is properly called an "upgrade," rather than the popularly-designated "promotion." The latter term should be reserved for positions which offer definite growth in responsibility or authority while an "upgrade" means the person has grown, by some measure of productivity or competence, within the current position responsibilities.

Fourth, skills within the programming area *are* readily demonstrable, or they can be made so. Fifth, these skills *can* be measured, although the existence and quantification of these skills is still a matter of debate. However, it is true that Miami-Dade's greatest difficulty in implementing competency-based jobs has been in the area of the objectivity and complexity of skill measurement.

History of Competency-based Job Description Development At Miami-Dade Community College

On March 8, 1976, Dr. H. P. Nicely, Dean of Planning, Research and Computer Services, established a Task Force to Develop

Competency-Based Job Descriptions. Members of the Task Force were selected from the two programming organizations within Computer Services. The charge included the following items:

.to develop recommended competency-based job descriptions for all computer programming and systems analyst positions from the entry position to the highest position beneath department supervisor.

.to recommend the optimum number of competency-based job descriptions

.to recommend a means by which full-time personnel already on board can be categorized or placed in the proper recommended competency-based job description.

The Task Force, after much analysis and deliberation, reported back in December 1976, with the following salient points:

1. The job categories comprising systems analyst tasks were eliminated from consideration for the time being.

2. A recommendation to establish five programmer levels of competency was made. A general outline of each position is shown on the following page (Fig. 2).

3. The Task Force established a major principle by noting that longevity or time-in-grade should be de-emphasized as a criterion for upgrading. "Time in a position does not necessarily determine knowledge, capability, and potential productivity," the Task Force noted. "Demonstration of capabilities should be a major factor in consideration of upgrading."

General Outline of Programmer Job Positions

Programmer I:

Codes from detailed program specifications. Performs all work under close supervision. Generally works on only one activity at a time. Usually an employee who has no previous experience.

Programmer II:

Works under immediate supervision. Has mastered basic processes. Can execute simple assignments moderately independently. Work is carefully checked.

Programmer III:

Works under some supervision. Fairly competent to work on several phases of the activities with only general directions, but needs some instruction and guidance for the other phases.

Programmer IV:

Works under minimal supervision. Can work on his/her own in most phases of the activity. Requires only some general direction for the other phases.

Programmer V:

Competent to work at the highest technical level of all phases of the activity. Works on his/her own most of the time. May give some technical direction to lower classifications. Usually is responsible for college applications dealing with the overall operating system or with complex sub-systems such as sophisticated file management routines, telecommunication networks, or advanced mathematical/scientific software packages.

Figure 2

4. The Task Force established detailed job requirements they felt were self-explanatory in terms of the knowledge and skill required at any of the five positions. In all cases, college policies and personnel guidelines were adhered to.

5. The Task Force established the principle that the first four levels of programmer jobs were necessary stages of development, with all programmers expected to attain the fourth level, with the amount of time required to reach the fourth level to vary according to "work responsibilities assigned to a programmer and the programmer's personal application to his or her career."

As the Task Force concluded:

> It is the intention of this proposal both to establish a clear path for job advancement and to promote the acquisition of a variety of useful skills at M-DCC. By defining a wide range of skills from which employees can select their optional requirements while maintaining strict technical requirements, the college itself will benefit by collecting a large knowledge pool to draw upon.
>
> This specific career path method will promote professionalism and boost employee morale through planned career development. Time requirements have been placed in a lower priority than was previously part of job descriptions. The Committee feels that time requirements have hampered growth in the past. The proposed new system will help to advance the better than average person at his/her real growth rate while identifying the marginal or less motivated person.
>
> A steady growth rate is in the college's best interest. This method may mean that at some point in time we will have no Level I, II or III programmers. Should this ever happen, the college would have a full contingent of skilled, professional and proven programmers.

Over the course of the next 15 months, refinements were made to the basic plan, to satisfy several concerns voiced by management. The Task Force worked valiantly to meet these concerns, primarily in four areas:

1. What are the critical competencies? The Task Force, itself reflecting the schizoid nature of the programming profession, was split between those who felt that specific coding skill was the basic criterion for success and those who felt that formal coursework, particularly, should also be a skill requirement.

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This is an over-simplification of a complex issue and the final result reflects a reasonable compromise, requiring both specific skills and education, with substitution allowed for either. For example, the Programmer IV requirements state the following mandatory requirements:

a. an associate's degree and two years' experience
or a High School education and three years' experience

b. the ability to write file maintenance programs

c. the ability to write programs from general specifications

d. the ability to use software utilities

e. proficiency in documentation

f. effective communication skills

g. proficiency in the use of Job Control Language

h. the ability to interpret memory dumps

i. proficiency in program optimization techniques

j. proficiency in the use of specific software packages

k. proficiency in testing and debugging techniques

(Coursework can substitute for two of the above proficiencies)

The Programmer IV, in addition, must satisfy four proficiencies in the following optional areas:

a. the assumption of system supervisory responsibility

b. the use of structured programming techniques

c. coursework or proficiency in management

d. coursework or proficiency in accounting

e. coursework or proficiency in mathematics

f. coursework or proficiency in statistics

g. coursework or proficiency in systems design

2. How are critical competencies to be measured? Most competency-based certification is test-related. One of the best examples is the Certified Professional Secretary examination, in which an "in-basket" exercise simulates a broad range of secretarial problems requiring certain skills whose mastery is measurable by how quickly and well the "in-basket" is depleted. The Task Force chose to approach measurement through job-related, rather than test-related criteria. As they noted:

> Generally speaking, highly-structured jobs lend themselves to skill measurement in an abstract way by means of tests. Persons attempting to demonstrate skills for such jobs can pass standardized tests to self-certify those skills. The driver's license examination is a good example of this kind of test-proving competency. The tests the Committee examined were, in addition, skill abstractions; for example, a beautician was required to tell time and compute percentages to prove competency. The Committee feels that programming tasks are very difficult to abstract, and are liable to be very incomplete in test form because a programmer works at such a spectrum of activities that any reasonable testing could cover only a subset of these activities. Consequently, the conventional method of measure by test seems to be nearly impossible in this field.
>
> If tests are not applicable measuring devices. what instruments are? The Committee used, instead, an even older tradition in going to job-related rather than test-related measurements; that of trade skill demonstration. As the apprentice electrician demonstrates his ability to do wiring without supervision to qualify as a journeyman, so should a programmer be able to demonstrate his programming-related skills capability on the job in order to make a case for his increased competency. The Committee, frankly, has a mistrust of any measurement of competency which is not strictly job-related. The Committee firmly feels that the method of competency measurement chosen, which requires strict observation of specific tasks which should be performed in the normal course of duty, is far superior to testing.

The Task Force devised an on-the-job measurement device for each of the skills required. The following page (Fig. 3) illustrates a portion of the Programmer IV measurement criteria.

III. Must be able to write programs from general specifications with minimal supervision.

Demonstrated by: Writing a production program given the I/O record formats, formulas to be applied and specific program processing considerations. No program flow chart or detailed logic help from supervisor or co-workers would be necessary.

IV. Must be proficient with software utilities.

Demonstrated by:

Option 1: Using utilities such as sort, merges, file dumps, file copies, library updates, and applying these utilities in the writing of JCL job streams for production and maintenance applications without help from supervisors and co-workers.

Option 2: Satisfactorily completing an administrative-approved course in utilities.

V. Must be proficient in documentation techniques as applied to flow charts, report layouts, file descriptions and functional job specifications.

Demonstrated by: Documenting a production job according to M-DCC documentation standards.

Portion of M-DCC Programmer IV Skill Criteria

Figure 3

A principle was established that each programmer would have a "transcript," listing job requirements for the skill level in question, which would be signed by his/her supervisor whenever the skill level in question was reached. For example, in Figure 3, once a production program was written and approved, given the conditions shown, that skill item would be certified on the "transcript."

3. How should performance measurement be tied to competency evaluation? The Task Force was confident that the required skills would be so difficult to prove on a sustained basis, the method of measurement was so carefully phrased, and the evaluators (supervisors) so committed to the process that there was little likelihood of someone being recognized for superior skill who did not also have superior performance. However, in order to fully safeguard the competency-based process, a set of requirements was added to the process to link the completion of a "transcript" with the college's normal performance evaluation form. Thus, someone who had certified his/her capability for upgrade was also evaluated in terms of conventional criteria. That is, skill certification time was the appropriate point at which to note such other traits as attitude. Without such a link, it would be theoretically possible for someone to possess all the requisite skills but be derelict in applying them consistently.

4. How could such a system be implemented? As noted above, a "transcript" was devised as the proper method for recording skill competencies. Because of the very serious problem of equitable initiation of the competency-based scheme, the following steps were taken:

a. Salary studies were undertaken to relate the five new programming positions to proper salary ranges both within the college and the Miami data processing community. This step also established the relative worth of any upgrade from one position to the next.

b. Existing salaries were adjusted to place each person within the new ranges and to establish parity with external salaries. (If this step had not been taken, further adjustments for competency might be misdirected. Competency upgrades should never be used to correct salary inequities.) This step was taken in March 1978.

c. All existing employees were given job titles within the new system, primarily corresponding with their old job titles. (That is, all Junior Programmers under the old system became Programmer II's, etc.)

d. In the period March through June 1978, supervisors carefully measured all programmers against the job title they held, preparing for each a temporary "transcript."

e. On July 1, 1978, each programmer was given either a clean "transcript" for the next-higher position or a letter noting which specific items needed satisfaction in their current job titles.

f. Programmers who did not qualify for their current title were given until April 1, 1979 to meet these qualifications in order to retain the title, and, thus, begin work on the next-higher competency.

Positive Aspects of Competency-Based Jobs

Competency-based job measurement gives programmers personal objectives. Instead of vague self-improvement programs, the programmer can strive toward specific goals. Furthermore, this kind of program standardizes those goals, so that all programmers are moving in the same direction as the organization. Of course, the goals themselves need organizational re-evaluation from time to time, but that is a small price to pay for the advantages.

Hiring practices were also standardized. With a specific list of competencies--at a much more comprehensive level than a job description--the manager now has the means to seek and screen very specific talent. At M-DCC, the hiring process became much more careful, with more and better technical questions asked of applicants. Hiring managers are often optimistic about prospective programmers; that optimism translates into hiring for potential instead of accomplishment. Although the interview process is always imperfect, as compared to on-the-job performance evaluation, competency standards cause that innate optimism to be tempered.

Career paths become well-defined and achievable. None of the disadvantages of the conventional job qualification survive under competency measurement. Programmers know where they stand with respect to the next-higher job position at all times. Neither vaguely written qualifications nor specific unwritten qualifications serve as barriers to advancement.

The proof of any advantage of competency-based job description is in whatever accomplishments ensue. Morale at M-DCC is tangibly better, with the issue of job advancement being a professional concern, rather than a materialistic or competitive one. Turnover has decreased. Importantly for the manager, the thrust of some of the competency criteria has pushed people into improvement; people are more inclined to accept technical responsibility, to venture into new techniques, and to take courses to upgrade their skills.

Negative Aspects of Competency-Based Job Descriptions

One difficult problem at M-DCC has been a result of the fact that a peer committee set the original criteria for competency. The Programmer V was characterized by this Task Force as a "Super Programmer," a person of greater capability than seemed necessary within the M-DCC environment. Now it happens that the described talents of the Programmer V are in actuality nowhere near the ultimate programmer. However, besides the problem of getting the Task Force to believe there are many skills beyond those described, there is the allied question as to whether these skills could realistically be attained or used in our environment. There remain some doubts, though, that the Task Force set its sights too low. In consequence, there is a management proposal being worked on at M-DCC which postulates the existence of a Programmer VI and also a Programmer VII. Perhaps there are other practical extensions.

One drawback was somewhat unexpected. There has been some difficulty experienced in retaining the Federal Labor Standards Act exempt (i.e., professional) status of Programmer IV's. A person in that category is expected to operate with great independence of action, on key administrative and management systems with professional initiative. Despite this, some personnel experts believe that any competency-measured position is, by definition, non-exempt. That is, any job measurement scheme which values skill in performance rather than some professional test cannot be used for exempt positions. If true, this could be a drawback, although it would seem that some language clearly specifying discretion and independent judgment could be used in the job description to ensure professional status. As noted in the Federal Register of December 2, 1971, Relative to the Status of Data Processing Employees, "A computer programmer would...be using discretion and independent judgment when he determines exactly what information must be used to prepare the necessary documents and by ascertaining the exact form in which the information is to be presented."[2] Discretion and independent judgment, for data processing employees, are specifically noted as criteria for FLSA exemption.

Another disadvantage is that there remains some subjectivity in the process. At Miami-Dade, the five programmer positions are characterized by a growth in technical proficiency, a growth in ease of activity, and a growth in technical leadership. Each of these are skills whose growth lies along a continuum;

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[2] James P. Titus, Wage and Hour Laws Specified for Computer Center Employees", Communications of the ACM, Feb 1972, p. 125.

to decide how to express the correct degree of growth and then to measure that growth is exceedingly difficult. The Task Force toyed with the idea of setting up artificial, standardized tests, but rejected it. (With this idea, someone trying to prove that he/she could use an OS dump would be given one with some time limit to find applicable items. Persons meeting the limit would qualify.) Too easily, such a series of tests could evolve into a game. Hence, the Task Force (rightly) chose to trust close observation of performance by knowledgeable supervisors over a lengthy time period. And that can be subjective, although it should be noted, in passing, that M-DCC did devise an appeal process in cases of supervisor/programmer disagreement concerning skill attainment.

Conclusion

Miami-Dade Community College is committed to a two-year test of Competency-Based Job Descriptions. All persons concerned view the test with enthusiasm. The high hopes for the project have already been justified in the first months of this system as programmers, their supervisors, and managers alike have all found advantages.

Acknowledgments

Credit for the ideas behind competency-based jobs at Miami-Dade Community College should be given to Dr. H. P. Nicely, Jr. Helpful suggestions for this paper were given by two members of the Task Force to Develop Competency-Based Job Descriptions, J. T. Carr, and G. W. Cold.

TRACK II
DEVELOPMENT OF INFORMATION SYSTEMS

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CONTENT CONTROLLED SECURITY IN A DATA BASE MANAGEMENT SYSTEM

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Most data security software appears to operate on a class or set basis, i.e. a user, be it department or individual, is permitted to access information defined under a particular field name or group of names. If we are to achieve some measure of progress towards a responsive and responsible information system, a security system which is based on a comparison between the characteristics of the user and the content of the data sought, must be developed. This paper discusses the criteria for content controlled security; some of the alternatives available under a particular data base management system (IMS); the selection and implementation of one such alternative and its possible general application.

Content Controlled Security

Introduction

While the IMS security provisions for on-line transactions appear comprehensive they fail to meet a very significant set of requirements. These requirements occur in the application of security that is related to data element content rather than data element name. This can best be illustrated by the example: Dept A is not permitted to charge a purchase to Dept B's account. The example is trivial in a manual system and can usually be ignored in a batch processing system, however, it requires significant programming in an on-line system since no "before-the-fact" control exists.

IMS/DC security

IMS can only deal with the problem by having separate transactions and PSB's (program specification blocks). All other solutions require code in the on-line application program. Since the situation is repeated many times in other instances it would be worthwhile to review the problem in some detail. Both dept a and dept b have access to data elements named "account-code" and "account-balance". The problem is therefore, to prevent one department from accidently or deliberately entering a transaction which could affect another department's account balance deleteriously, i.e, the transaction's origin must be correlated with the contents of "account-code". In batch this is achieved by simply matching the "account-code" elements in the transaction and the data base (file). Since the piece of paper (indent, p.o.) will pass through several operations the "account-code" error will probably be caught before the update process. In an on-line system the error, except for non-existent account codes, may not appear on an expenditure control report for several weeks.

Confidential data

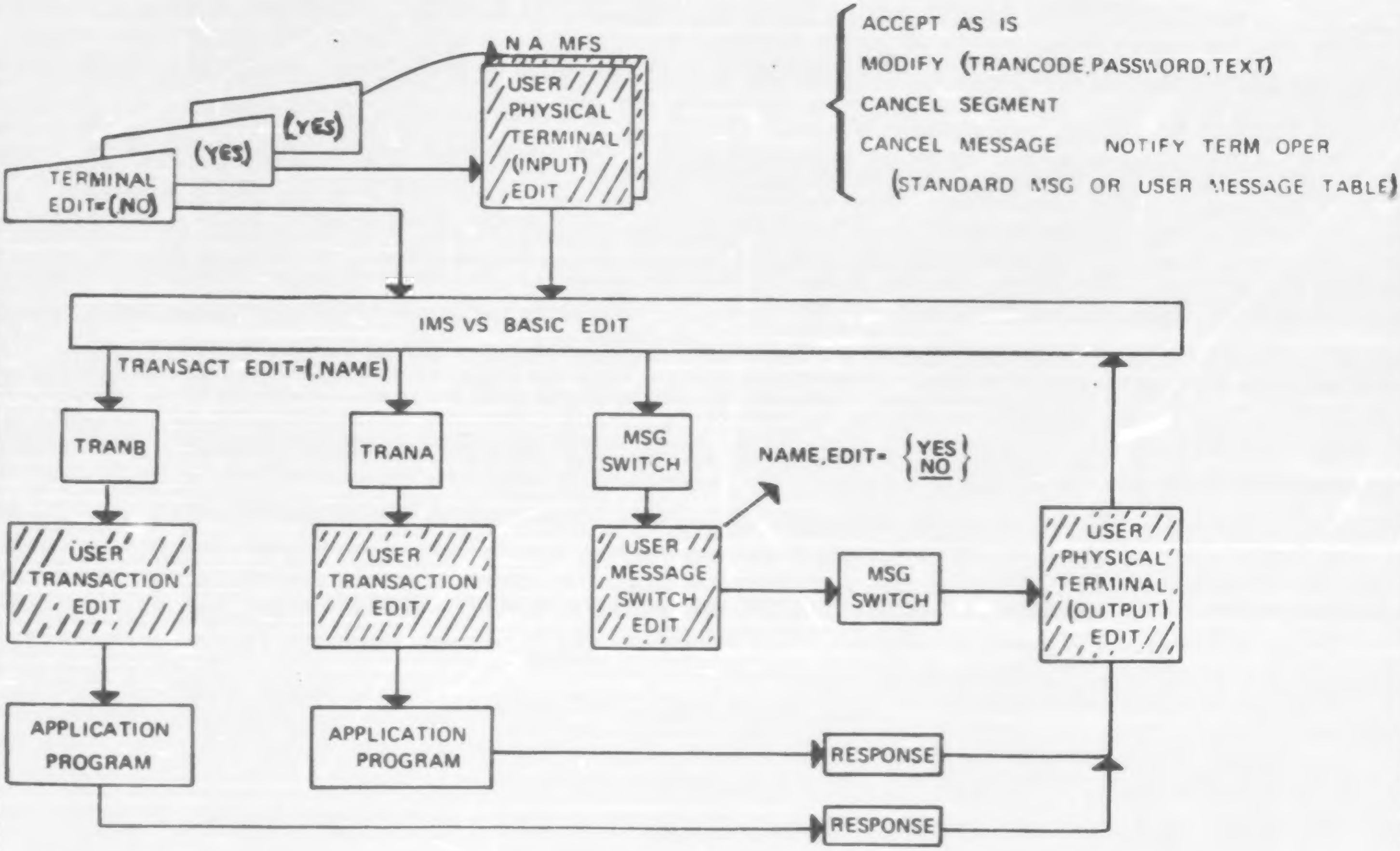
As stated earlier the above is merely one example of a universal problem which becomes very important where confidential data must be made available to departments and where access is to be restricted by content. The problem has the added complication in that departments A and D may come under different supervision to departments B and C. In such cases, e.g, vice-presidents, the supervisors would require multiple authorization, once for each department under their control. Because of the recurring needs and multiple authorization, content controlled security must be:

available to many programs under central control
complementary with IMS security measures
compatible with future development
effective in on-line systems

Alternatives:

There are several methods to accomplish content controlled

OPTIONAL USER EDITS



ACCEPT AS IS
MODIFY (TRANCODE,PASSWORD,TEXT)
CANCEL SEGMENT
CANCEL MESSAGE NOTIFY TERM OPER
(STANDARD MSG OR USER MESSAGE TABLE)

security, they are: encryption, message editing and application invoked routines.

Encryption - a technique whereby data is "scrambled", using a key, before being stored. The stored data is unscrambled using the same key after it is retrieved and before it is displayed or printed. The simplest implementation of encryption is the segment-related edit (compress/decompress) which is specified at data base definition (dbd) time in IMS.

Message editing can be accomplished in several ways and at different points in transaction processing cycle. The diagram "optional user edits" illustrates the points schematically. The first is the physical terminal input edit, the second is before the transaction is released to the application program and the third, and last, is the physical terminal output edit.

Application invoked routine is a "copied" procedure or subroutine which acting on application program supplied data matches the origins of the transaction with the contents of the sensitive data element. The routine sets an indicator to true or false depending on whether the match was successful or not.

The table entitled "content controlled security" matches each technique against each objective thus providing a rapid comparison among them. The findings contained in table are summarized in the conclusions which follow. Conclusions

Encryption segment editing since the exit is related only to the particular segment-name the security will have to be applied in batch as well as on-line systems. While this could be advatageous in the more distant future the immediate requirement is for a measure that incurs minimal application progrmming. The knowledge of IMS/DC internals required to implement a security measure based on the segment edit would probably take months rather than weeks to acquire. The difficulty is not in the actual coding of the routine but obtaining the transaction and the logical or physical terminal identifiers. Segment editing, as a content controlled security measure, does not appear to be a feasible alternative in the short term. It requires more study to determine its long term feasibility.

Transaction/terminal editing the exits are associated with either transaction or physical terminal exits. The transaction exit is available only before the application program is scheduled, ie, on input only. The physical terminal exit is available on both input and output. Except as an auxiliary function to the terminal edit the transaction edit holds little promise. The output terminal edit will need access to the sensitive data element contents, transaction and possibly logical terminal identifications. All three could be supplied from the application program hence a knowledge of IMS/DC internals is not imperative in this case. The complexity would lie in the handling of all messages destined for a particular physical terminal. Terminal (output) editing appears to have the

CONTENT CONTROLLED SECURITY

CRITERIA SELECTION TABLE

Criteria	Encryption Segment edit/IMS exits	Transaction/Terminal Editing	Routine Procedure/Subroutine	Remarks
Available to multiple programs	Any program accessing the named segment will invoke the edit	Any program activated by a particular transaction or originating from a particular terminal will cause the transaction to be "edited"	Any program can invoke the ROUTINE - it would be made a "standard" for particular transactions	Application programs have to be cognisant of the existence of "content-controlled" security measures
Under central control	Yes, the exit and segment are matched at DBD generation time, difficulty occurs in obtaining LTERM and PTERM data	The edits are included at sysgen time, application programs would have to make sensitive element contents available	Application programs would have to make sensitive data element content and LTERM-name available	All three methods use tables which although susceptible to tampering in various degrees can be seeded with spurious data
Complementary with IMS security	Yes, the IMS security measures have already been invoked by the time the module has been activated	IMS security measures have already been invoked by the time the module has been activated	The design of the ROUTINE would assume that IMS security has been applied	IMS provides for:- a) transaction & password b) transaction & terminal c) transaction, terminal and password
Compatible with future development	Segment edit is a standard IMS facility	Transaction/Terminal edits are standard IMS facilities	Inasmuch as the ROUTINE may be modified/replaced to suit changed conditions	Future developments could include more terminals transactions and software
Considerations in: a) on-line b) batch	a) It is effective in on-line systems b) Since it is segment related batch programs	a) It is effective in on-line systems b) Since it is terminal and/or transaction related it will normally be ignored in batch systems (BMP's can be an exception)	a) It is effective in on-line systems b) Can be omitted/bypassed in batch application	Security must be effective in on-line systems and incur minimal work in application programming for batch
Remarks	Since the exit is specified for a particular segment name the application program has no control Several types of security measures are possible	There are three types of trans/term edits: a) physical terminal input b) physical terminal output c) transaction(input)	The ROUTINE is designed to perform a table look-up to match the logical terminal name with the content of the sensitive data element	

greatest feasibility within this subset, however, the complexity involved pre-empts it as a short-term alternative.

Routine. A standard routine invoked by the application program appears to offer the simplest and least costly implementation of content controlled security. The routine was written in PL/1 for evaluation and then transferred to IBM-370 assembler and although more susceptible to deliberate tampering than other alternatives it offers an almost immediate alternative at significantly lower cost. It should provide most of the logic and code required to implement a future system based on the terminal edit user exit. The application program for a particular transaction would "call" the subroutine immediately after 1 4 the sensitive data element contents become available then providing these, the transaction name, and the logical terminal (lterm) name and a "true/false" results indicator fields to the subroutine. On return from the subroutine the application program, depending on the results indicator, would continue normal processing or generate messages to both the master terminal and the transaction origin indiating a security violation. The application program would return to a state of normal readiness for the next transaction.

Implementation

Content controlled security has been implemented as a subroutine CALL-able from on-line application programs. While the application still performs the database access call, retrieving the contents of the "security field", performs a second call to the security subroutine passing the contents of the security field, a "status" return code and the transaction and logical terminal names.

The routine performs simple binary searches on security field contents, transaction and terminal vector tables which return the respective offsets to a three dimensional bit matrix "look-up". The absence of the bit at the intersection of the three offsets indicates that access is not permitted. The status return area reflects the subroutine result to the application program which takes appropriate action. An interface between those applications requiring security and ims is envisaged such that violations will be logged on the master terminal.

Security of the routine is acheived by batch recompilation on a regular basis. The tables and matrix are in a passworded dataset and all contain spurious values which should deter all but the most determined violator.

The routine as currently designed is somewhat unsatisfactory since two new IMS-related program products are being installed. The Generalised Information System(GIS/VS) which users have as a batch report generator can circumvent most IMS security measures unless carefully implemented and controlled. The other is the Application Development Facility(ADF) which provides for full IMS security but does appear to be able to control by content.

As a result of these two software packages, the encryption approach will be re-examined. Double enciphering techniques are envisaged with the contents of the control field used as a key.

Parallel Data Base Development

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While most institutions have taken the approach of serially developing data bases in the five major data areas identified by NCHEMS, the University of Tennessee took the approach of developing first a Facilities Data Base and then proceeding with the other four in parallel. The objective of this approach was to get all of the data bases designed and loaded in a reasonable time frame. Having data available in each of the data bases then allowed production of integrated informational reporting. After the data bases were available for general use, effort was expended to develop operational systems to keep the data current.

Following this approach, it was paramount that a strong DBA staff be available from the start of the project. This DBA staffing occurred in conjunction with the staffing of the Facilities Data Base effort. By the time this initial project was completed and parallel data base development begun, the DBA staff was able to provide the support required by these multiple projects in the areas of training and education, standards, backup and recovery, control block generation and security.

Part I

Parallel Data Base Development

Prior to 1974 the University of Tennessee was interested in developing data bases similar to those described by NCHEMS. The President had appointed committees to structure Data Element Dictionaries in the student and faculty/staff areas. Since the University of Tennessee consists of five campuses, a Central Administration and an Institute of Agriculture, each of the units were represented on these committees.

Development Plan

During the winter of 1974 an outside consultant was hired to put together a plan for the University to follow in developing a data based Management Information System. This plan included references to the many activities that had already occurred and acted as a catalyst to getting the project moving. A report, "A Management Information System Plan for the University of Tennessee" by Morris Branch, was presented to the President's Staff in July 1974.

The plan suggested the development occur on five levels.

Level I Develop Reporting Data Bases

This was to include the design of the data base structure, initial loading (and subsequent reloading) of the data which was on existing files and the production of initial reports.

Level II Refresh the Data

Level I requires a complete load (or reload) of the data at any point in time the data base is deemed to be out of date. Level II provides a means of making batch corrections only to the items that have changed since the data base was last refreshed. This allows the data bases to be kept more accurate with less computer time required.

Level III Convert Operational Systems to Interact with the Data Base

At this level the data would be kept up to date by operational systems that interact with the data bases. These operational systems would replace the existing ones.

Level IV Terminal Inquiry

The first three levels of development pertain to batch processing. Level IV allows for on-line data inquiry and informational reporting.

Level V Terminal Update

This final level allows the data to be added, deleted or changed by means of on-line terminal processing. This could be done by individual data element updates or terminal data entry for later batch updating.

This plan also suggested that the Facilities data area be used as a pilot project followed by parallel development of the other four data areas (Student, Academic Program (Course), Finance and Faculty/Staff). As the parallel development was occurring, a Data Base Administration (DBA) function should also begin. Figure I shows the timing at the various levels proposed in the plan.

The approach suggested seemed to run contrary to the direction most institutions were heading at the time. This approach was selected for four primary reasons.

1. Establishment of a Uniform Data Base Structure

   With all of the data bases being designed in parallel, there would be a thread of commonality through them all and consequently easier to understand by the technical staff.

2. Establishment of Data in Data Bases

   After the data bases were designed, the data from existing files

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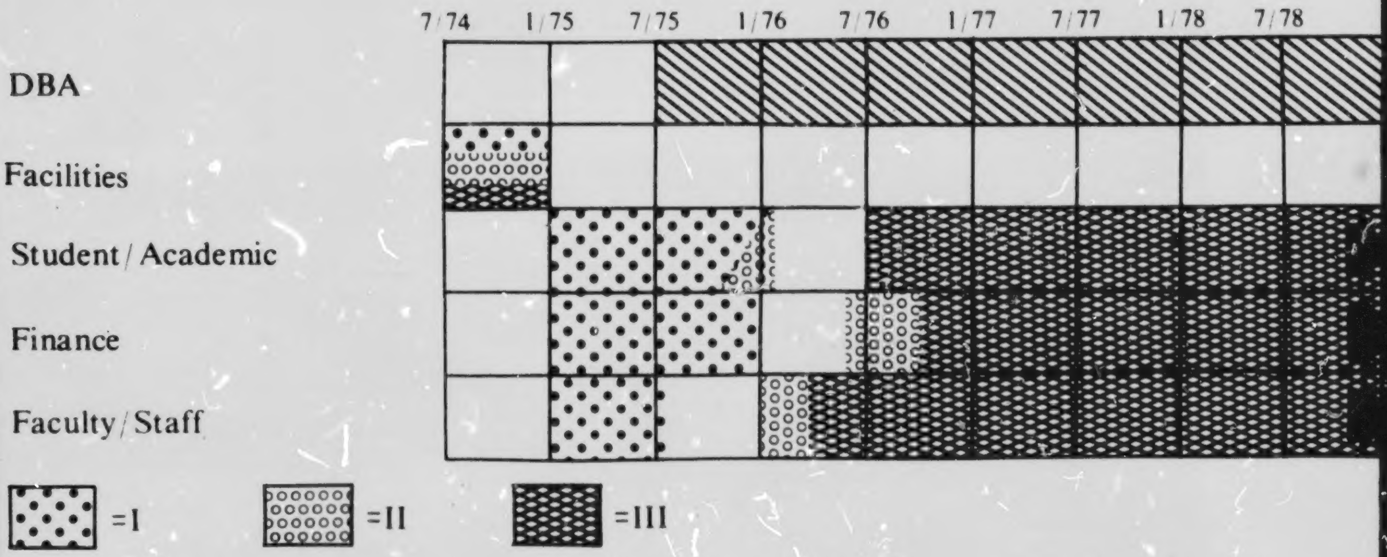
FIGURE I

Branch Plan



could be loaded. This would allow for early loading of all of the data bases with a minimum of effort.

3. Earlier Availability of Information for Management

   With data loaded in each of the data bases, integrated management information reports could be produced. This fact proved to be one of the major selling points of the approach. The data bases were designed to yield rapid informational reports to management and then begin to add operational systems rather than having to wait until many of the operational systems were in place before integrated reports could be produced.

4. Orderly Approach to Evolve to Complete Data Base and MIS

   This approach would insure that from the outset data would be available for use from all of the data bases. Having this to work with, operational systems and reports could be developed in an order which best served the needs of the University. This contrasts to having the order of system development determined by what data is available or by what data must be made available for subsequent systems development.

Pilot Project

The Facilities Data Base was chosen for the pilot project for the following reasons.

1. The system needed to be very small. It was known from past experiences that the number of data elements needed on facilities was small and the reporting requirements were few. Also the process for updating the data was simple.

2. Ninety percent of the data that would be needed existed on one tape file. Having most of the data that would be required collected and on one file was a big plus. Only a few additional data items were required and therefore very little new data would need to be collected.
3. The informational needs were well defined. It was known that certain reports were required for production of the H.E.G.I.S. Facilities Report and various other governmental agencies. There was also the need to list various attributes about buildings and rooms (such as door number, building name, etc.). These lists would help in keeping the data up to date and accurate. Various other special reports would be requested on an ad hoc basis. These types of reports are part of the justification for having data bases, however.
4. Low Visibility of the Project

   It was hoped that only a few people outside the professional data processing groups would be involved in the project. This low visibility was needed to allow for corrections of mistakes and false starts. Since the Facilities area is the least complex of the data areas and is accessed and viewed by the fewest people, this low visibility was possible in the Facilities area.

Development

The President's Staff accepted in July 1974 the report produced by Mr. Branch through Level III. In other words, the batch development of data bases and information systems would proceed but the use of on-line terminal retrieval and updating would be delayed until after the batch system proved successful. If at that point terminal processing could be justified, it would be considered. With this acceptance of the plan, the University of Tennessee began in-depth development of a data based MIS. One of the first things that was done was the establishment of an office for Management Information Systems and Data Base Administration (MIS/DBA). This office was to have primary responsibility for ensuring that the MIS project happened in an orderly and concise manner. The MIS/DBA office was established in August 1974. It was the intent of the President's Staff to have this office for leadership purposes. The technical people that were to work on the projects were to remain in the professional programming groups but work on the data base projects. In November 1974 work began in earnest. A team of people were assigned to work on the DBA initialization function (this is discussed later) and another group was assigned to work on the Facilities Pilot Project.

In April of 1975 as the pilot project was getting ready to wind down, a team was formed to develop both the Student and Academic Program Data Bases. These two projects were handled by the same team because of the close relationship between them. The team that was to develop these two data bases was composed of twelve people. The team leader and co-team leader came from a Central Administration data processing office. The other team members came from the campuses; the Knoxville campus provided five members and one member of the team came from each of the other campuses. This team worked together in Knoxville for a period of eight months to get the projects well started. After the team members returned to their respective campuses, they continued to work on the projects but at a reduced rate until June 1977 at which time both data bases were declared to be in a production status and ready for the campuses to load the data, keep it updated and develop appropriate operational systems.

The financial project did not get started until July of 1975. This team consisted of six people, all from the Central Administration data processing staff. It was decided that the new operational financial system would go into effect with the 1978 fiscal year. The budget preparation process was one of the first systems that needed to be operational. It was functioning on schedule in the spring of 1977. The other parts of the core financial system were ready by the fall of 1977. While it had been hoped that all of the systems would be ready by July 1977, the delay (although it caused a fair amount of nervous tension) did not cause any significant harm or damage.

The faculty/staff project was also staffed from the Central Administration data processing staff. Five people have been assigned to this project since July 1975 except for a period of eight months when they were shifted to the financial project to help it make the approaching deadline. The Faculty/Staff Data Base Project completed Level I by the summer of 1977 and has continued to reload the data.

Present Status

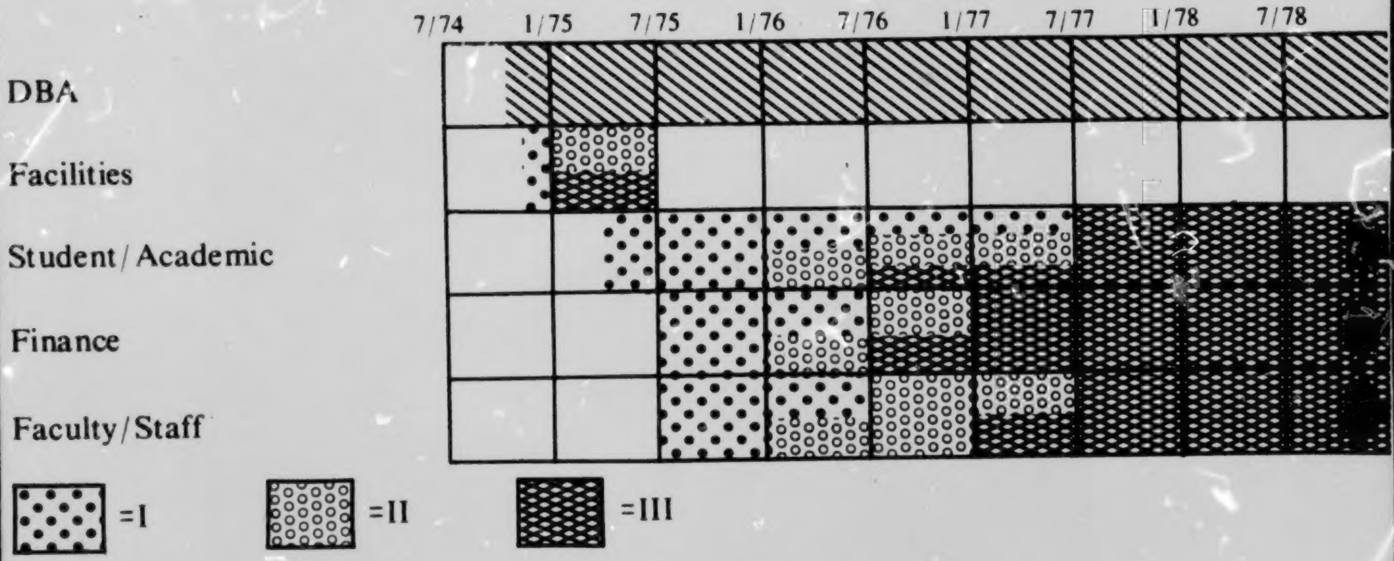
The five data base areas have all been available for use and have had data loaded in them for at least a year. The Facilities Data Base has data on 1090 buildings and there are some 30 reports that are regularly used. Data has only been loaded in the Student and Academic Program Data Bases by one campus. However, this campus has information on some 67,000 students, 12,000 courses and 39,000 sections. The student data is used for frequent retrievals but the course data is not extensively used at the present time.

The Financial Data Base contains data on some 20,000 accounts and is heavily used by the operational financial system. The Financial Data Base is also very heavily used by other data base areas and some non-data base systems. The Faculty/Staff Data Base has data loaded on about 37,000 employees and this is regularly updated with changes in personnel and payroll information. This data base is used for frequent reports and often used to produce reports that were very difficult to obtain prior to the availability of the data bases.

The concept of developing the data base area in parallel has worked well at the University of Tennessee. It has allowed early loading of data and production of integrated reports much quicker than the conventional way of developing operational systems for a data area first and then producing informational reports. Figure II illustrates the amount of time that has been required to go through the various levels. With the successful implementation of batch oriented data bases, the time has now arrived to begin work on Level IV and V.

FIGURE 11

Actual



Part II

Data Base Administration Development

The DBA Initialization Project

From the start of data base development at the University of Tennessee, it was assumed essential that the Data Base Administration function be pursued concurrently with other data base efforts. To accomplish this, a DBA Initialization Project was set up to be run in parallel with the Facilities Pilot Project (FPP). At the time there was little expertise available within the University as to what the DBA function was all about. Authors writing about data base all seemed to include it. But, how DBA should operate within the University of Tennessee environment was an unknown.

The DBA Initialization Project Team was set up to include seven members: a project leader, three analysts, two programmer/analysts and a programmer. This organization may sound top-heavy, but the process was regarded primarily as one of planning and analysis. The programming effort would come later. Three members of the team were assigned half-time to the DBA group and half-time to the Facilities Project team. This plan was intentional in order that communications between the two groups be maintained. The project leader and two other full-time DBA team members had been involved previously in the DBMS selection effort. The team contained, therefore, most of the data base technical expertise which existed within the University at that time.

The team set out immediately to establish some ground rules for operation. It was essential to set up objectives for the project. These objectives were derived from our intuitive sense as to what would be required, from readings regarding the suggested development of DBA and from pressures which quickly emerged from the Facilities Project. After much discussion and research, the following objectives for the DBA Initialization Project were defined.

1. Identify DBA Activities and Functions
2. Develop Data Base Education
3. Develop Standards and Functional Guidelines
4. Investigate and Install Software
5. Utilize FPP as a Guide for Development
6. Respond to User Needs

This set of objectives represented a starting point from which further progress could be made and responsibilities assigned. In general, the process utilized to pursue these objectives was top down in nature in that each was analyzed from a very general to a very detailed level. It was only at the detail level that we were able to make visible progress.

Another major task at the start of the project was to identify those functional guidelines which were to provide a rationale for the DBA function and to establish a framework within which DBA could operate. This task was not difficult since these guidelines were similar to those established as a rationale for pursuing data base as a technology by the University. These functional guidelines were:

1. Data is a major University resource;
2. Responsibility for data and the data base is shared;
3. Long range University goals and immediate user needs must be considered;
4. The quality of the data base environment will be enhanced through the centralized coordination and performance of the DBA function.

These guidelines were used as a basis upon which many DBA standards, procedures and operating practices were established.

The DBA Initialization Process

The first step in the initialization process was to define the data base environment in which we expected to operate. This definitional phase resulted in many iterations all revolving around the five basic components of the data base environment as we saw them: the data base, the data dictionary, data base administration, the data base management system, and the user/system interface. These components are defined below and their interactions within the data base environment are further explained.

The Data Base Environment

The Data Base, as seen within the University structure, can be defined as the "logically" centralized and organized repository for all data belonging to the University. By this definition, data is viewed as a major University resource. One of the ultimate goals of the data base concept is to define the logical relationships that exist among the various types of data collected and maintained by the University in order that these relationships can be accessible through automated data processing. Thus the data base would reflect the status of University data as it actually exists--having multiple uses and affecting multiple applications. It should be noted also that, according to definition, this data need not be physically stored in the same manner, medium, or even location. And, while some centralized physical storage may be advisable for processing efficiency, it is not always a prerequisite for obtaining the "logical" control and centralization required by the data base concept.

The Data Dictionary is a major tool that assists in establishing, centralizing, and reporting the various logical relationships that exist among University data. As such, it can be defined as the repository of all definitive information about the data itself. This information includes such things as the definition, length, and origination of a particular item of data. In addition, the catalog can report logical relationships existing between that piece of data and other data items in the data base, providing that such a relationship has been defined previously.

Another essential component of an effective data base environment is Data Base Administration. A subset of this function, the administration of data, has been operating within the University environment since the Institution's beginning. However, in a data base environment, the centralization of the logical interrelationships between all University data requires that this function be also centrally controlled. Thus, the term Data Base Administration refers to the human function of maintaining responsibility for, and coordination of, all University data-related activities that occur within the data base environment. Data Base Administration does not propose to replace the valuable data administration functions performed by each individual user department. In a data base environment the user has an even greater responsibility for the definition of data and the specification of how it is to be viewed and utilized. However, Data Base Administration performs a custodial function over the data as a service to the user. Part of that responsibility is to attempt to satisfy user needs for data and to observe overall University policy toward the availability of such data.

The Data Base Management System (DBMS) can be described as a software function designed to perform the physical storage, retrieval, and maintenance of data within the data base. In the U.T. environment, this DBMS function is performed by an IBM software package called the Information Management System (IMS). Implied under this component are certain maintenance functions to be performed such as updates and enhancements to the package, tailoring the package to fit installation requirements, and general coordination and communications as to the status of the DBMS.

The User/System Interface is primarily a software component. As viewed within the University structure, it consists of those software subsystems which permit multiple classes and types of users to interface with other components of the environment in order to structure effectively the available data into information. This is the component which allows users to access required elements of data, to relate them in an appropriate logical manner, and to convert the related data elements to usable information. In the most universal sense, the example of this interface would be an application program. However, the interface includes all of the software features which are utilized to obtain access to the System, such as subroutines, report writers, languages, and algorithms.

In reviewing these five components of a data base environment, it is obvious that Data Base Administration must exercise responsibility for coordination and management of the other four components. As such, the DBA function becomes the key to an effective Data Base Environment. However, DBA is only one of many groups that require data base interaction. The organizational structure of the University demands that specific functional responsibilities for various components of the environment be assumed by specialized departments. Therefore, in order to coordinate all the areas of interaction with the data base environment, DBA must be able to establish and maintain those communications and procedures necessary to guide the joint efforts of all responsible agencies toward the development of an effective data base operation.

Data Base Education

Another huge area of effort which occurred at the beginning of the initialization process was the development of a program of data base education. The goal was to educate a staff of over 30 people to a point where they were able to use data base technology and provide the technical expertise to support the University's commitment to data base development. In this direction a comprehensive set of internal courses was developed by members of the DBA initialization team. This program contained the following sessions:

1. Data Base Concepts - an overview of data base concepts and terminology;
2. CODASYL Concepts - a review of the progress of the CODASYL committee in an attempt to standardize the approach to a data base language;
3. The University Environment - a discussion of how data base development could affect University operations;
4. Data Base Architecture - a review of the various data structures which are used by current data base technology;
5. Data Base Design Concepts - a detailed study of the process of designing a data base including data element definition, process definition, hierarchical element organization, and logical structures; and
6. IMS Concepts and Application Programming - an externally developed set of audio/video programmed instruction courses covering IMS concepts and programming techniques.

This series of courses was presented several times to different technical groups during the first two years of data base development.

Data Base Standards

Almost from the start of both projects, the demand for standards was apparent. Naming conventions were first on the list of developing user needs. Such conventions were difficult to derive since we were trying to develop formats which would satisfy immediate FPP needs and yet would survive an unknown environment. Nevertheless, the idea of standards was an important concept in the DBA initialization process. One team member was assigned the full-time job of developing a Standards Manual. Many others on the project contributed various sections. A great many of these standards were developed through brainstorming sessions and intensive discussions between members of both teams.

The process of standards development started with a basic outline of what was required. This was expanded as our technical knowledge grew. The effort took amost eight months. It was a painful effort but one which was most rewarding at its completion. The first University of Tennessee Standards and Procedures manual was published in August of 1975. Throughout the data base development effort, this manual has proven to be one of the most valuable products of effort expended throughout the DBA Initialization Process.

DBA Technical Expertise

It was essential that the DBA team build up a base of technical expertise which could be relied upon by applications personnel. This was done in part through a series of IMS classes sponsored by IBM and in part by the old reliable trial and error method. It was in this area that our parallel development with Facilities really paid off. The experience gained from developing the Facilities control blocks was invaluable. Contrary to all the usual recommendations to keep the data base fairly simple, our first Facilities DBD contained logical relationships. This was done to provide a security access path to the data belonging to each University campus and yet allow the University Central Administration to access all of the data for University-wide reporting purposes.

It is recognized that this technical expertise is not easy to come by. Rather it is a task which must be pursued with great effort in order to provide a technical support base for data base application.

Code Support Implementation

One of the software capabilities which was developed and implemented during the DBA Initialization Process was a Code Support system. The system was designed to support the storing of coded data within the data bases and to provide the capability to perform verification and translation of this coded data. The codes are supported through an IMS HDAM data base where the code value was transformed to a four-byte root segment. The second level of the data base contained a segment type which contained the attributes for a particular code type represented by the root value.

During the initialization process, DBA developed the Code Support data base, the update mechanism, and the callable subroutines used by applications programs to verify the validity of a code or to obtain its textual translation. This software feature was developed in time for use by the Facilities applications.

Although considerable enhancements have been made to the system over the years, changes to the initial callable routines have been transparent to the user. DBA involvement in the area of codes has extended to user assistance in the development of code values and attributes, coordination of all updates to the codes data base, the standardization of a format in which the codes are documented, and the publication of an IMS Reference Manual containing documentation of all valid code values associated with each existing code scheme. Currently this document is automated and reference pages are printed directly from the data bases.

Standardized COBOL Code

As we became familiar with the operation of IMS, it was apparent that many portions of the working-storage section of COBOL programs could be standardized and reused by multiple sets of source code. Since it was considered a DBA function to maintain the data base specifications (DBD's, segment relationships, etc.), it was also logical that DBA should provide the standardized COBOL I/O areas required for each data base segment. To accomplish this, DBA initially coded the I/O areas based upon element and segment information defined by the applications teams. These I/O areas were catalogued to PANVALET to be included in source code as required. (PANVALET was already the facility generally used to store and update source code.) This capability was quickly expanded to include SSA's, PCB masks, and field qualification statements for SSA's. Naming conventions on PANVALET were standardized so that given a segment or DBD name, one could obtain the associated PANVALET member by adding a standard prefix (IO=IO Area, SA=SSA, PC=PCB Mask).

This feature has been a great time saver in terms of limiting duplication of effort, coding standardization, and ease in learning to develop IMS programs. Currently whenever a change in segment definition occurs, all these features can be generated directly from our Data Dictionary.

The Data Dictionary

Early in the DBA initialization effort, investigation began as to an appropriate software package to perform the Data Dictionary function. After a moderate evaluation effort, IBM's Data Dictionary System was selected. DBA then became involved in implementing the package, learning the command language, and setting up guidelines for data entry. We also determined an official name for the system which now is known as the Data Resource Catalog (DRC).

In Facilities development, segment names and element names and definitions were stored in the DRC for documentation purposes. However, the value of the DRC did not come into reality until after both FPP and DBA initialization were over. Currently, extensive use is made of the DRC in control block maintenance and the generation of standardized COBOL code, data element dictionaries, and Code Support references. Users are now exploring the potential for maintaining other types of system documentation within the DRC.

Data Base Maintenance Procedures

Another technical area which required attention during this process was the development of procedures and utilities supporting the data base maintenance effort. Experimentation was done with the Code Support data base as this was the first data base available for testing. During this experimental process, the following procedures were established.

1. Most maintenance job streams were catalogued in a procedure library to minimize the amount of JCL being submitted.
2. A generation data group of log tapes was catalogued to be utilized by all data base update programs.
3. A manual log of tape inventory information for log tapes, image copies, log accumulations, and reorganization jobs was established and maintained on a daily basis.

All of the above procedures are still used although enhancements have been made in each area.

Security Requirements

The problems involved in determining an approach to data base and data security were difficult during initialization and continue to be an ongoing problem. The security question centered around certain issues: security of the data bases, security of the data within the data bases, and security of the data base software, including IMS.

The University computing environment added to these complexities. The U.T. Computing Center (UTCC) operates a combined installation for both academic and administrative users. The installation also supports remote rje/rjo centers in several locations on the Knoxville campus as well as on other campuses in Memphis, Martin, Nashville, Tullahoma, and Chattanooga. It was necessary for data base applications to be submitted from all remote campuses as well as from several remote locations at Knoxville. Therefore, security had to accommodate the existing environment.

The security of IMS was addressed by the Systems' Programming staff from UTCC by the development of an IMS "front end" routine. Specifications for this software were developed jointly by UTCC and the DBA team. This software provided the following features.

1. All IMS application programs execute the "front end" routine rather then calling IMS directly.
2. IMS was modified so that "it" could be executed only through this piece of software.
3. The "front end" verifies the PSB name provided in the application JCL against an access list data set containing valid project code information for that PSB. This is matched against the job accounting information. Mismatches cause job cancellation. DBA maintains this access list data set.
4. The "front end" software creates historical records as it processes each IMS job request. This data set is used daily by DBA to obtain data base activity information and to assist in data base maintenance.

This software has proven to be quite effective. Over time it has been enhanced to provide additional activity information, security checking of PSB access intent, and the verification of log tape JCL in update programs. In the overall security issue, the biggest problems occur in the manual authorization procedures required to initiate the security process.

Products of DBA Initialization

The DBA Initialization Project lasted approximately ten months. At that time personnel on both FPP and DBA teams were reassigned to continue the data base development effort in other areas. The permanent DBA team was assigned four members from the DBA Initialization Project team. At this point the DBA effort was directed toward refining the procedures developed during initialization and turning the DBA staff into a productive support group. The results of the initialization effort made this assignment feasible. While refinement and enhancement are continuous for DBA, the following products developed throughout the project were sound and provided a basis on which to build.

1. A viable program of data base education
2. A comprehensive manual covering standards and procedures for the University data base environment
3. A code support data base and supporting software which provided for the verification and translation of coded data
4. A working Data Resource Catalog data base with basic update and reporting software
5. A system of standardized COBOL code to support the programming effort within the IMS environment
6. The basic software to support data base and data security and plans for future enhancements to this software

7. A defined list of functions and responsibilities to be assumed by the DBA effort

   These responsibilities include the following:

   a. Develop and administer data base standards and procedures,
   b. Coordinate data base specifications,
   c. Provide education in the data base environment,
   d. Promote practices to maintain data security,
   e. Coordinate data base software development,
   f. Support and coordinate data base maintenance activities, and
   g. Provide data base consultation service.

Trends in DBA Development

Throughout the years of data base project effort, the DBA function has continued to be an important part of data base development. The functions of data base maintenance are time-consuming but have settled down to a routine. Control block generation is a daily occurrence. The Code Support, DRC, and Security Systems have been greatly enhanced and are supporting the environment. The DBA staff is busy in consultation activities in every aspect of the data base environment. The data base Standards Manual has been updated several times and is providing basic operational guidelines. However, as in any dynamic environment, user needs keep changing and requiring continuous DBA awareness and response.

Present staffing of the DBA team is still set at four. Team effort is usually directed on a priority basis to the following areas:

1. Technical Support - those tasks that are essential to the ongoing operation of the environment;
2. Project Support - those consultative or project related tasks which assist in the continued development of data base applications;

3. Environment Support - those tasks which provide enhancements to the environment in either software or procedural areas.

It is certain that both the DBA function and the staffing will continue to grow in the University environment. Emphasis on data administration will increase as relationships between data base areas are explored and utilized. Currently the University is about to undertake a progression from a batch to an on-line data base environment. It is anticipated that many of the steps followed in DBA initialization will be repeated in this process. This time, however, there is a functional DBA group already established and a wealth of IMS experience available among applications personnel. With this background the challenges of an on-line data base environment will be readily undertaken as an opportunity for continued DBA development and growth.

COMPUTERIZED SUPPORT FOR DYNAMIC SYSTEMS DEVELOPMENT

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This paper will explore alternatives to traditional systems development. Emphasis is placed on the problems associated with the development of dynamic systems which can function in an environment characterized by change.

A number of traditions are critically examined including:

> The Freeze Syndrone--portrayal of the Systems Design Freeze concept as the greatest single aid to effective implementation of ineffective systems.
>
> Manuals are Memorable--viewing of traditional systems and procedures manual preparation as an archival process which, in a dynamic environment, equates to the Monday morning game plan.
>
> Muddling through Modularity--portrayal of program modularity as the generation of a blizzard of programs whose most singular accomplishment appears to have been to insure a vanishing gestalt.
>
> Preservation through Participation--high user participation viewed as a vital key to preservation of the status quo.

Approaches for dealing with change by creating dynamic systems will be presented and one alternative is examined in greater depth.

The development of computer-based administrative systems is, indeed, an enormous task. The professionals confronted with primary responsibilities for analysis, design and implementation for new systems have necessarily been resourceful in developing a methodology and accompanying techniques which facilitate their work. The questions which we intend to raise in this paper do not challenge the reasonableness of existing systems methods and techniques given the conditions under which they evolved. Rather, using the advantages of hindsight we would ask you to join us in a candid assessment of the extent to which those methods and techniques support the more encompassing goal of developing dynamic systems which are efficient and effective in an environment characterized by change. We should point out at the onset that we propose to view the problem from a particular perspective (a bias if you will). That is, we have looked at each of a series of methods and techniques as they relate to "change".

It requires no great scholarly effort to recognize that engaging in the development of a computer-based administrative system is tantamount to placing oneself at the vortex of institutional dynamics. Two dimensions to this process are virtually apparent at the onset of any development effort. First, there is the system-as-change agent dimension. That is, the development process and later on, the operational system frequently does cause change. The second dimension is equally apparent to those who have previously experienced automation, namely the system-as-change-object dimension. Here it is important to view both developing and operational systems in their ability to deal effectively and efficiently with changes which are thrust upon them.

In the following sections we have first attempted to view a few of the techniques which have been traditionally utilized during systems development as they relate to the second of the change dimensions mentioned above. Further, we have tried to identify problems associated with use of those technique and hypothesized about alternative techniques which might deal more appropriately with the forces of change. Lastly, we have attempted to describe facilities which have developed at the University of Albany, which we feel address some of the center-most change-issues and which hold promise for future development of truly dynamic systems.

COMPUTERIZED SYSTEMS--OBJECTS OF CHANGE

Computerized systems exist in a dynamic business environment. While conceptually we understand the need for these systems to be responsive to the ever-changing needs of business, we are (in our more pragmatic moments at least) cognizant of the cost and numerous pitfalls inherent in the change process.

The sources of legitimate change are varied. Change may emanate from:

(1) New ideas and objectives
(2) New people and organizations
(3) New or changed information requirements
(4) New or changed services and processes
(5) Discovery

It is a contention of this paper that much of our attention has traditionally focused on a singular set of problems -- how to deal with the change which is induced as a result of developing computerized systems. We would like to redirect that focus for a moment to a new set of problems -- how to develop dynamic systems which accommodate change quickly, effectively, and naturally.

CURRENT TECHNIQUES

There has evolved a set of techniques for dealing with (managing) change. Several will be examined in greater detail as a part of this paper including:

- User Participation
- The Design Freeze
- Modular/Structured Design
- Documentation

Of course not all of the above techniques are explicit change strategies and that is not really important. What is important is that when they are employed during system development they have a pronounced impact on how "change effective" the new system will be. Let us proceed now to look at each of these techniques more critically.

PRESERVATION THROUGH PARTICIPATION

User participation throughout systems development has become normative for most institutions and the days of non participative development are gleefully gone. Most administrative systems personnel view this active participation by users as important in that it provides them with access to vital information about the work process which they do not possess. Also, it is felt that this participation fosters understanding, commitment and feelings of ownership by users which can help to make the system a success.

Notwithstanding the somewhat ideal view portrayed above, most administrative systems personnel sense that there are very real difficulties in putting the concept of user participation to work.

Viewing the process from a very different perspective for a moment we might make some rather harsh statements about it. For example, we might point out that user participation is, in fact, a subtle form of change strategy and that it:

- Encourages maintenance of the status quo
- Minimizes the creative exploration of alternatives
- Seeks to gain a commitment to discourage future change.

Perhaps too, the problem is not just with the user community but rather in our ability to effectively maximize and support user participation. For example, we invite the users to explore alternatives with us and simultaneously inform them that they must make selections, decisions, and commitments conceptually without seeing or experimenting with a tangible product. Indeed, traditional programming does take time and exploratory systems and programming is costly. However, the fact remains that in such an environment "big change" can be equated to "big risk".

This has led us to speculate that if we could construct a solution which would maximally contribute to the development of dynamic systems it would include:

- Active User Participation

  plus

- Technical facilities which permit
  - exploration of design alternatives
  - simulation of consequences
  - change without reprogramming

THE FREEZE SYNDROME

The concept of the systems design "freeze" is one which evolved as a way of bringing order and closure to the development process. In principle it seeks to:

1. structure the environment so as to encourage an early thorough design review by users and management
2. structure the environment so as to encourage decisiveness and accountability within user and management offices
3. reduce the total number of variables which must be dealt with during programming and implementation

Viewed in a different way the design freeze can be seen as a very direct attempt at controlling change. It seeks to institutionalize an attitude about change and to utilize group consensus and organizational power as agents of enforcement.

In addition to being generally unrealistic the freeze concept has a number of rather specific flaws. First, it fails to recognize that non attention to change is not equivalent to non existence of change. Furthermore, it encourages working under the illusion of a static environment which, in turn, precipitates static systems. More important, the freeze concept impedes constructive change and serves as the greatest single aid to the effective delivery of outmoded and ineffective systems.

Obviously we are not pleased with the design freeze concept as a solution to very real problems. In attempting to idealize an alternative solution to these problems we are beginning to feel that there are at least two required components --one managerial and one technical. At the managerial level there is need for an approach which legitimizes change but which attempts to structure that change. Such an approach would represent a striking contrast to the freeze concept which tends more towards the notion of ignoring change.

The second, technical, component would contain facilities which support change by permitting data and process changes without reprogramming.

MUDDLING THROUGH MODULARITY

We personally ascribe to concepts of structure and modularity. In particular, we feel that the objectives of structured modularity are important and that existing tools and techniques enable us to go a long ways towards meeting several of those objectives including:

- Making complex problems more intelligible
- Keeping programs small and simple
- Eliminating coding redundancies
- Facilitating change --e.g. can add, delete or modify small program modules quickly

However, when we begin to think about truly large systems and the way in which we typically program those systems we begin to have a few problems with the concepts. In particular, we sense that any large scale attempt can result in a virtual "blizzard" of programs. This increases the number of "things" which change can impact and introduces the need for a new level of coordination. While the program modules may be small, simple and easy to read we have concluded, like Aristotle, that a lot of anything (even a good thing) is hard to control.

Believing as we do in the twin concepts of structure and modularity we have attempted to hypothesize an ideal environment for large systems in which:

- There would be very few programs required
- These programs would be small, simple modules of code
- These programs would readily accommodate changes in data and process

Without these additives structured modularity may serve simply to insure a vanishing gestalt.

MANUALS ARE MEMORABLE

In a relatively short period of time we have come to recognize the importance of documentation as an important aspect of systems development work. While its rapid emergence was in part a reaction to high-turnover rates associated with data processing personnel, it has really come to mean much more than simple protection. Indeed, today documentation is used to facilitate development of new systems, assist in problem analysis, educate user staff and evaluate progress. All of this is in addition to its usefullness as a technical description and safeguard.

Some feel the process of documentation has over-developed to the point where it is difficult and time consuming to access specific information from a growing mound of paper.

It is also true that changes in documentation actually chase changes to systems. We believe this stems from a dual-path change procedure. That is, each change involves two separate paths of activity -- one which changes the system and the other which changes the documentation. The changes are implemented sequentially and frequently by different people. The net effect is that documentation is either out-of-date or inaccurate. Thus its many potential advantages remain just that -- potential.

In our idealized solution we would find methods for improving the accessing problem and for eliminating the dual path procedure. That is, reference to the instruction set for performing work would be fully integrated into the work itself. Also changes to the system would simultaneously effect a change in the documentation and vice versa.

SUMMARY ON CHANGE

We have thus far attempted to review several well established systems tools and techniques from a somewhat different point of view -- namely their relationship to a process in which computerized systems become the object of change. Throughout the discussions we have tried to hypothesize about improvements which could be made and which would further maximize the opportunity to develop dynamic systems. In the following sections of this paper we will attempt to describe a set of facilities developed by the University at Albany which seek to make very real the sorts of technical support about which we hypothesized in the previous sections.

The first step in providing this new level of technical support was to identify a set of additional design objectives. These objectives were to:

- Minimize the number of application programs
- Provide automatic documentation of application process characteristics
- Build intepretive, table driven systems so as to facilitate application re-design
- Build systems which provide functionally simple methods for constructing and activating on-line transactions.

Several software tools were already available to us and could be used effectively in a dynamic systems development environment. These tools included on-line text editors, report writers, on-line query languages and a sophisticated data base management system.

What was missing was a tool which could bring to bear all of the essentials of on-line transaction processing, e.g. terminal screen formatting, error handling, data editing, data security, data I/O, and, most importantly, data grouping. Thus the University embarked on an ambitious program to develop such a product.

We quickly determined that this type of transaction processing required a series of programs (facilities) which would have ready access to data characteristics as well as to the data itself (Data Dictionary). In addition we felt that we needed the capability to quickly react to changes in transaction characteristics. What was needed was a type of transaction dictionary (Directory) which could be easily modified on-line.

Thus we used the name The Dictionary/Directory Facility. The Dictionary/Directory Facility (DDF) has two components. First, it consists of a series of computer tables which store information about data elements, terminal transactions, report characteristics and security. It is also a series of generalized computer programs which when completed will allow both user office staff and computer center staff to manipulate the informational tables and application data. In addition, DDF is a concept in computing which stresses user participation in the construction of the computer process and which is optimized for environments characterized by change.

DDF is intended to meet four primary goals. The first is to reduce application development time and program maintenance by reducing the number of programs needed for the application. The second is to provide an applications development tool which will maximize user involvement in the design process. The third is to provide an automated documentation facility capable of providing user offices with accurate and timely information concerning the operation of their system. The fourth is to provide a vehicle for the rapid change of computer processes so as to better react to changes in application requirements.

DDF Components -- DDF is first and foremost a series of computer tables frequently referred to as a metabase. This metabase contains information describing many of the characteristics of the computer application. Specifically, the metabase has detailed descriptions for each data element in the data base,each application transaction, and each report.

The element descriptions include specifics as to size and location of the element, retrieval authority, update authority, the standard mneumonic for the element, and element editing characteristics. The transaction description includes identification of the office which established the transaction, a transaction title, a list of elements included in the transaction, the screen location for each of the elements, and technical information which can be used to locate each of the elements required by the transaction. The report description includes data which describes the characteristics of the report. These characteristics include the elements to appear on the report, the number and location of any totals, the sequence of the report, the identification of the office requesting the report, statistics as to the frequency of the request, and other information needed to successfully process the report.

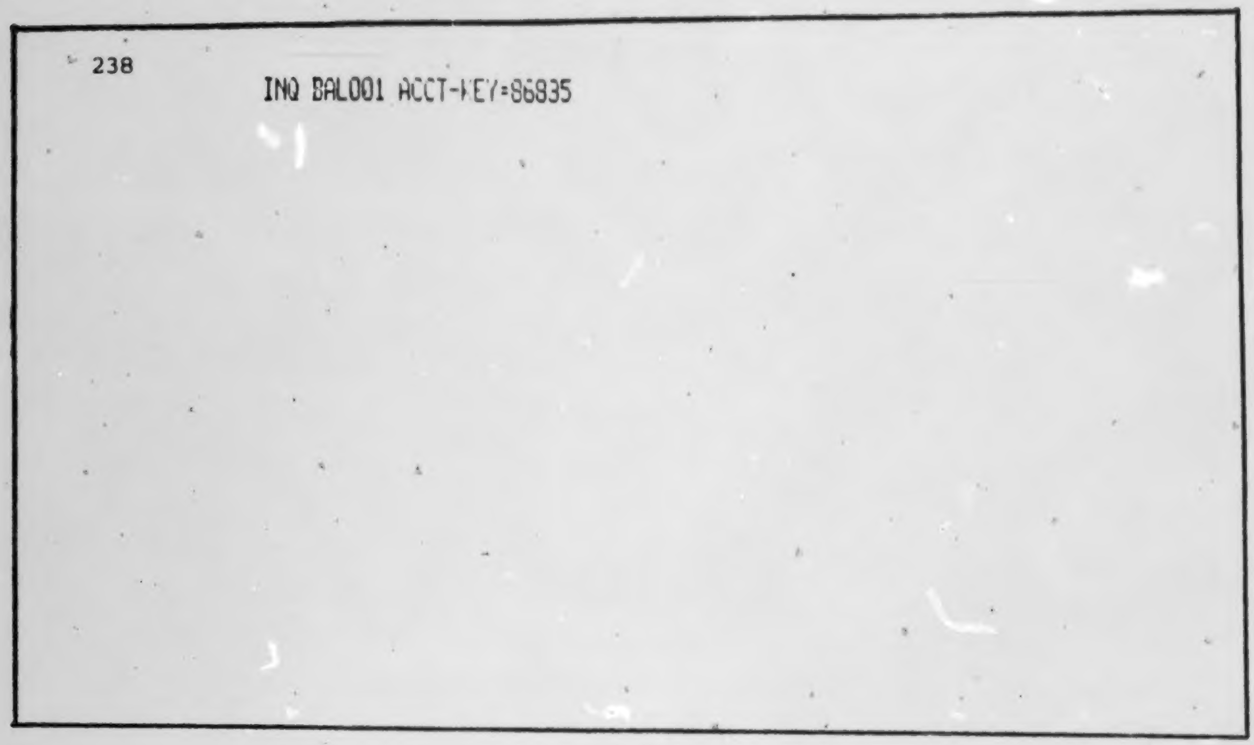
Screen Formatter -- A screen formatter program gives both the user offices and computer center staff the ability to retrieve and update information from the data base. In essence the screen formatter organizes a terminal screen using previously defined specifications. This occurs whenever the terminal operator inputs the transaction name and the identifiers for the data record(s) to be retrieved (see Figure 1.1). The data is presented to the user in both an aesthetic and a functional manner (see Figure 1.2).

Each data element is identified with a common mnemonic. Data elements for which the user has update authority are presented on the screen in unprotected mode (i.e. they are changeable). Data elements for which the user office does not have update authority are presented on the screen in protected mode (i.e they are not changeable). Any data element which is encoded on the data base will be translated into appropriate english language text. Using the screen formatter it is possible to automatically preestablish the coding for the next transaction should the initiating transaction be one of a sequence of transactions.

User offices are able to change any data element for which they have authority to do so by merely tabing to the appropriate element on the terminal screen and typing over the old data

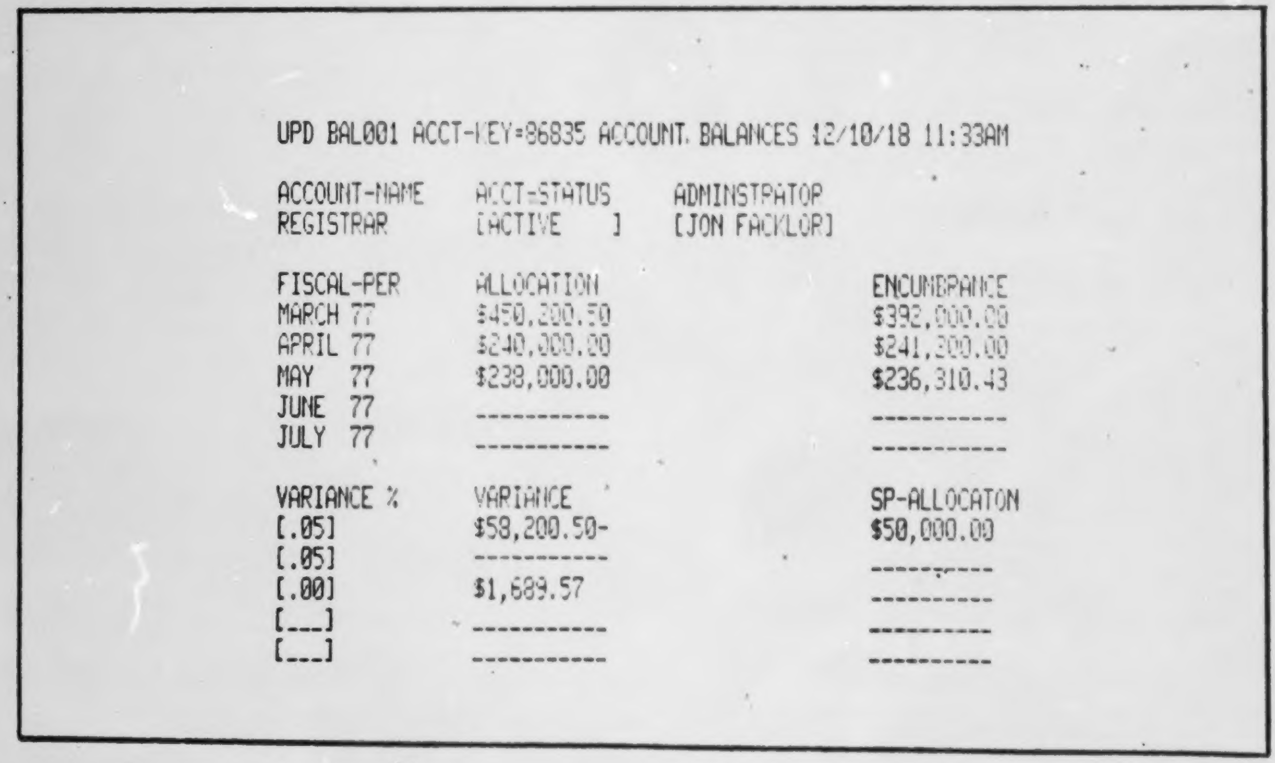
The screen formatter facility initiates a series of edit routines so constructed as to minimize the possibility of bad data entering the system. When screen formatter successfully updates the data base it simultaneously creates a computer record indicating the elements which were changed, the data which had been in the element prior to the change, the new data, the office which initiated the change, and the date and time that the change was effected. These computer records will be used for subsequent reporting to user offices.

Edit errors which are detected by DDF during an update function are highlighted by a blinking asterisk. The entire UPDATE SCREEN



```
238
            INQ BAL001 ACCT-KEY=86835
```

FIGURE 1.1



```
UPD BAL001 ACCT-KEY=86835 ACCOUNT BALANCES 12/10/18 11:33AM

ACCOUNT-NAME     ACCT=STATUS      ADMINSTRATOR
REGISTRAR        [ACTIVE     ]    [JON FACKLOR]

FISCAL-PER       ALLOCATION                          ENCUMBRANCE
MARCH 77         $450,200.50                         $392,000.00
APRIL 77         $240,000.00                         $241,200.00
MAY   77         $238,000.00                         $236,310.43
JUNE  77         -----------                         -----------
JULY  77         -----------                         -----------

VARIANCE %       VARIANCE                            SP-ALLOCATON
[.05]            $58,200.50-                         $50,000.00
[.05]            -----------                         ----------
[.00]            $1,689.57                           ----------
[___]            -----------                         ----------
[___]            -----------                         ----------
```

FIGURE 1.2

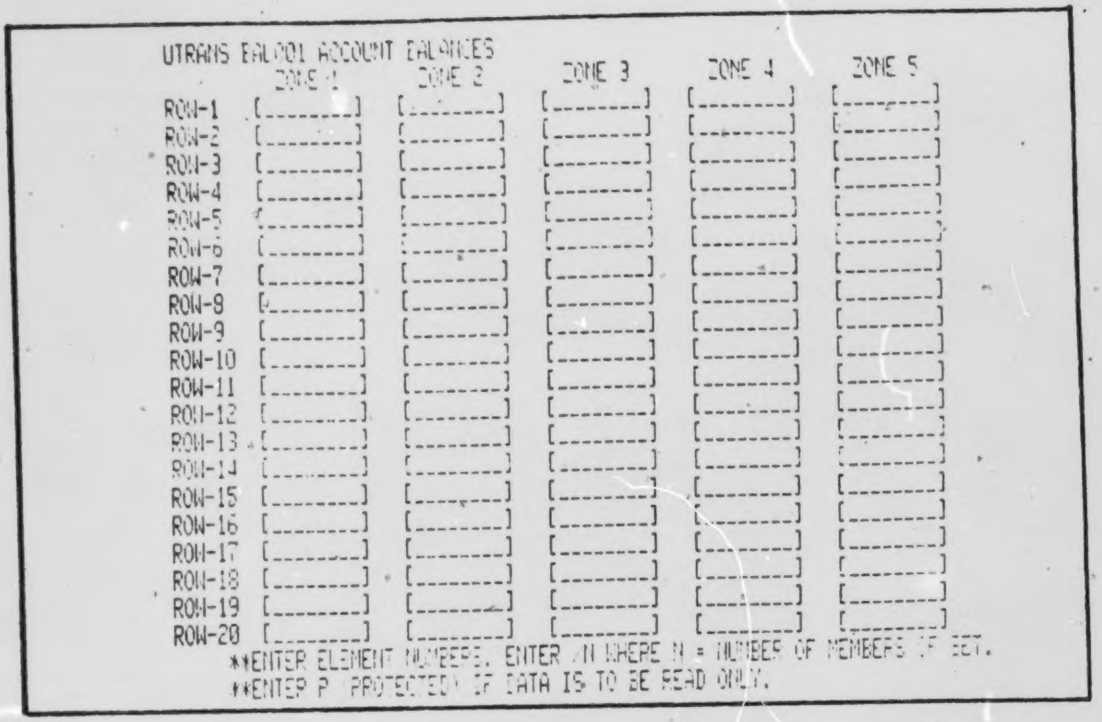
is returned to the terminal so that the operator can examine the incorrect data within the context of the entire transaction. If even one element in a transaction fails the edit test then no other element in the transaction will cause an update to the DATA BASE. However, because the entire UPDATE SCREEN is returned to the terminal, it becomes a simple matter for the operator to correct the error element and proceed again to process the update.

Data Management System (DMS) -- DDF contains information which it uses to locate computer records needed to successfully complete the transaction. This facility minimizes the need for user training in the intricacies of computer processing. It also assists in enabling the creation of a single generalized DMS I/O module.

Transaction Processor -- DDF provides a facility for building terminal transactions on line. This process has been designed to be as simple as possible so as to encourage user office staff to participate in the building of their own transactions. To construct a transaction the terminal operator would merely type in an appropriate command and the name of the new transaction (see Figure 2.1). The computer will respond by displaying a terminal screen split into five vertical sectors (see Figure 2.2). It will request the terminal operator to identify elements to be retrieved by typing in the appropriate element numbers in the desired area on the screen. The terminal operator may also specify the number of occurrences of an element in the event that it is necessary to have a given element appear from more than one data record (see Figure 2.3).

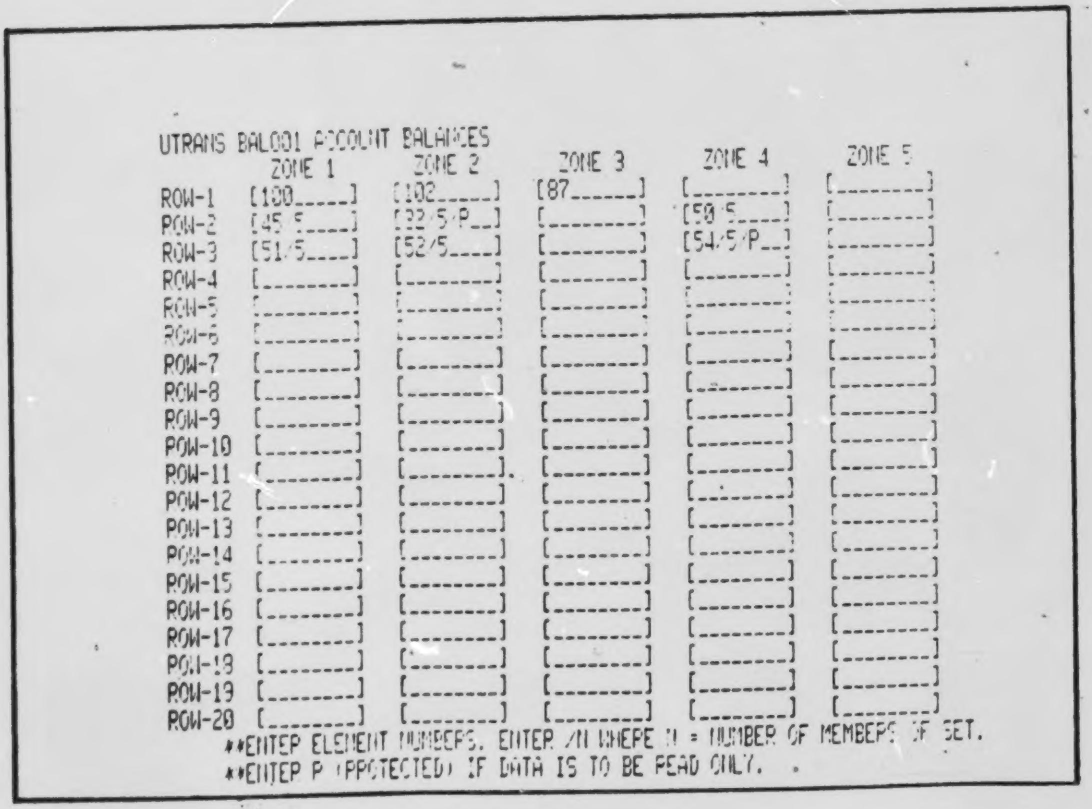
```
TRANS BAL001 ACCOUNT BALANCES
```

FIGURE 2.1



```
UTRANS BAL001 ACCOUNT BALANCES
        ZONE 1         ZONE 2         ZONE 3         ZONE 4         ZONE 5
ROW-1   [________]     [________]     [________]     [________]     [________]
ROW-2   [________]     [________]     [________]     [________]     [________]
ROW-3   [________]     [________]     [________]     [________]     [________]
ROW-4   [________]     [________]     [________]     [________]     [________]
ROW-5   [________]     [________]     [________]     [________]     [________]
ROW-6   [________]     [________]     [________]     [________]     [________]
ROW-7   [________]     [________]     [________]     [________]     [________]
ROW-8   [________]     [________]     [________]     [________]     [________]
ROW-9   [________]     [________]     [________]     [________]     [________]
ROW-10  [________]     [________]     [________]     [________]     [________]
ROW-11  [________]     [________]     [________]     [________]     [________]
ROW-12  [________]     [________]     [________]     [________]     [________]
ROW-13  [________]     [________]     [________]     [________]     [________]
ROW-14  [________]     [________]     [________]     [________]     [________]
ROW-15  [________]     [________]     [________]     [________]     [________]
ROW-16  [________]     [________]     [________]     [________]     [________]
ROW-17  [________]     [________]     [________]     [________]     [________]
ROW-18  [________]     [________]     [________]     [________]     [________]
ROW-19  [________]     [________]     [________]     [________]     [________]
ROW-20  [________]     [________]     [________]     [________]     [________]
     **ENTER ELEMENT NUMBERS. ENTER /N WHERE N = NUMBER OF MEMBERS OF SET.
     **ENTER P (PROTECTED) IF DATA IS TO BE READ ONLY.
```

FIGURE 2.2



```
UTRANS BAL001 ACCOUNT BALANCES
        ZONE 1         ZONE 2         ZONE 3         ZONE 4         ZONE 5
ROW-1   [100_____]     [102_____]     [87______]     [________]     [________]
ROW-2   [45/5____]     [32/5/P__]     [________]     [50/5____]     [________]
ROW-3   [51/5____]     [52/5____]     [________]     [54/5/P__]     [________]
ROW-4   [________]     [________]     [________]     [________]     [________]
ROW-5   [________]     [________]     [________]     [________]     [________]
ROW-6   [________]     [________]     [________]     [________]     [________]
ROW-7   [________]     [________]     [________]     [________]     [________]
ROW-8   [________]     [________]     [________]     [________]     [________]
ROW-9   [________]     [________]     [________]     [________]     [________]
ROW-10  [________]     [________]     [________]     [________]     [________]
ROW-11  [________]     [________]     [________]     [________]     [________]
ROW-12  [________]     [________]     [________]     [________]     [________]
ROW-13  [________]     [________]     [________]     [________]     [________]
ROW-14  [________]     [________]     [________]     [________]     [________]
ROW-15  [________]     [________]     [________]     [________]     [________]
ROW-16  [________]     [________]     [________]     [________]     [________]
ROW-17  [________]     [________]     [________]     [________]     [________]
ROW-18  [________]     [________]     [________]     [________]     [________]
ROW-19  [________]     [________]     [________]     [________]     [________]
ROW-20  [________]     [________]     [________]     [________]     [________]
     **ENTER ELEMENT NUMBERS. ENTER /N WHERE N = NUMBER OF MEMBERS OF SET.
     **ENTER P (PROTECTED) IF DATA IS TO BE READ ONLY.
```

FIGURE 2.3

The transaction processor verifies that the office initiating the transaction has retrieval authority for each of the elements in the transaction. It then returns to the operator a simulated screen showing how the data will look when the transaction is initiated. In addition, the computer will identify to the operator all retrieval keys which are required in order to get the data records.

DDF maintains the characteristics of each transaction in its metabase library. Therefore, the user office will be able to use a given transaction as often as necessary without having to redefine the transaction characteristics.

Transactions can be built by users in a matter of minutes. Because of the simplicity of building transactions we expect that the facility would be used in a trial and error mode to assist in the development of new applications. This ability to change the transactions "on the fly" will provide user offices with a new found independence from the constraints of computer programming. This should lead to higher quality systems and systems which are more responsive to the needs of user offices as more alternatives can be readily explored before committing to a design.

Element Processor -- DDF provides on line and batch utility programs for building and modifying element descriptions. This tool is intended for use by application development teams and/or data base administrators. It allows us to describe element characteristics to the system without resorting to program changes, re-compilations, or data base modifications. New data elements can painlessly be introduced into the system. Security and edit coding can quickly be modified to suit changing conditions. Data base simulation becomes a reality.

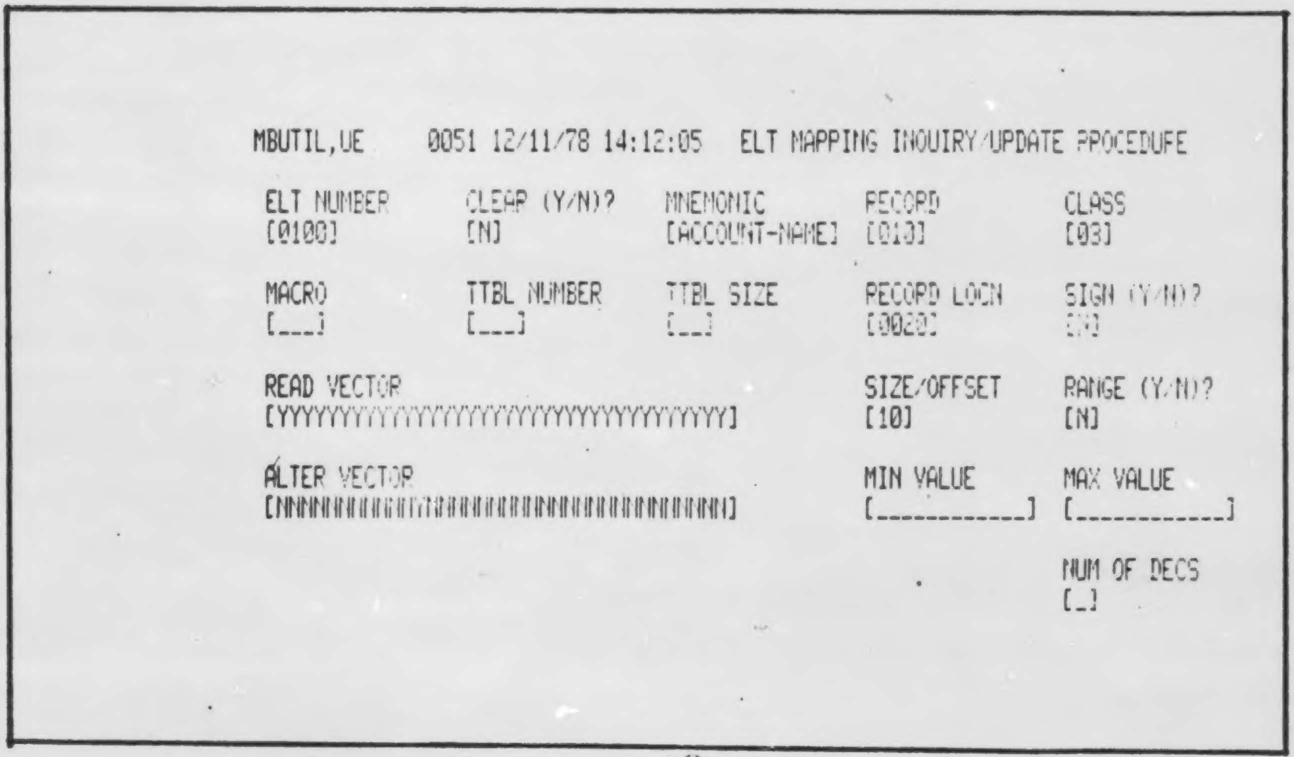
Again, simplicity of operation is stressed. To access an element description the operator merely enters a code and the element number. (see Figure 3.1). Element characteristics can be changed by simply tabing to the appropriate field and typing the new data (see Figure 3.2).

Report Writer Interface -- DDF will give user offices the ability to schedule the running of previously defined system reports. DDF will also provide a facility for assisting user offices in the building of specifications for new reports. Reports so constructed will be cataloged in the DDF metabase so that future runs can be initiated by user offices by merely referencing the report identification number.

As with the screen formatter, the Report Writer Interface will perform a comprehensive security check to insure that a user office has retrieval authority for elements that are being requested on a report. It will also automatically maintain statistics on the numbers of times that reports are created and run by user offices and on the number of times that given elements appear on reports.

```
MBUTIL,E 100                                          243
```

FIGURE 3.1



```
MBUTIL,UE    0051 12/11/78 14:12:05   ELT MAPPING INQUIRY/UPDATE PROCEDURE

 ELT NUMBER       CLEAR (Y/N)?    MNEMONIC         RECORD        CLASS
 [0100]           [N]             [ACCOUNT-NAME]   [010]         [03]

 MACRO            TTBL NUMBER     TTBL SIZE        RECORD LOCN   SIGN (Y/N)?
 [___]            [___]           [__]             [0020]        [N]

 READ VECTOR                                       SIZE/OFFSET   RANGE (Y/N)?
 [YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY]             [10]          [N]

 ALTER VECTOR                                      MIN VALUE     MAX VALUE
 [NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN]             [__________]  [__________]

                                                                 NUM OF DECS
                                                                 [_]
```

FIGURE 3.2

DDF will construct a computer runstream each day, such that computer center intervention will be held to a minimum. This will dramatically increase the probability of timely reports being delivered to users.

Documentation Generator -- DDF will provide up-to-date and timely documentation on all application parameters. This documentation will include information on data element retrieval and update security, transactions, and reports. In addition it will provide statistics indicating systems usage. The documentation capability is made possible by the metabase concept. Since the information contained in the documentation is already stored in computer tables it is quite a simple matter to print this information at appropriate times. Since the data is being printed from the same tables that are used in the process it is clear that the documentation will be current.

Technical Implications -- DDF is being developed on a UNIVAC 1110 computer. It is utilizing various UNIVAC software packages including COBOL Level 4R1, CMS Level 6R1Q2, TIP and DMS Level 7R2.

DDF transactions do not exceed 25 K words in size. Disc storage is approximately 1000 tracks. Operational costs for TIP transactions have been recently set at 10¢ per transaction.

DDF utilizes UNIVAC compatable synchronous 24 line X 80 character CRT terminals. These terminals utilize a full editing package including tabing, reverse video, blinking, protected and unprotected fields.

Recovery is handled thru DMS recovery procedures. I/O to both metabase and data base is centralized in a group of common I/O routines.

Summary on DDF Characteristics -- We believe that the DDF facility will have a major impact on administrative systems development. It has dramatically reduced the number of programs required for new systems. In so doing, it will dramatically reduce the maintenance load for these newly developed systems.

DDF will also have a major impact on the University as a whole. Since computer processing is no longer exclusively tied to programming effort, change is less traumatic and, in many cases, encouraged. The ability to respond to change has maximized our ability to keep application systems in sync with existing business needs.

DDF will produce sound, up to date, and timely documentation for user offices. This self documenting facility will both enhance the integrity of applications as well as reduce the maintenance load on administrative systems development staff.

On line updating of the application data bases automatically makesuse of DDF's data element editing logic. The same logic will be applied no matter which individual or office attempts to update a given element. This ensures that data maintains its consistency regardless of the source of change. Processing consistency is maximized by the use of common subroutines including those for editing elements and those for doing I/O to the data base.

DDF provides an effective **security** link between offices and data. This link is in the form of retrieval and update authority parameters keyed to data elements. All access to data from DDF is screened by these security routines.

DDF will enhance the scheduling and running of batch reports by pre editing requests and automatically generating runstreams.

DDF has been designed to be both comprehensive in scope and simple in execution. It will, therefore, encourage user offices to take a direct role in creating many transactions and reports. This "bypassing" of administrative systems development will no doubt free up programming resources for use elsewhere.

In summary,we will review DDF from the perspective of our four new design objectives:

- DDF consists of only 8 programs thus dramatically reducing the number of programs required to support on-line applications.
- System functions are defined in the meta base and thus are easily documented using standard report writer facilities.
- Elements and transactions are defined in the meta base. Both are easily changed on-line with no reprogramming or compilation required. Design, re-design, and re-re-design can be accomplished in minutes.
- The transaction processor and the data processor are designed for simplicity of use and thus encourage user involvement in application design.

We believe that in DDF we have made significant progress toward our ultimate goal of developing dynamic systems which accommodate change - quickly, effectively, and naturally.

A USER ORIENTED PRODUCTION CONTROL SYSTEM

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This system has been used for three years at Carnegie-Mellon University to control accounting and payroll data processing production. The system, however, is independent of the kinds of processing it controls. It was designed to permit non data processing personnel to reliably run large, complex, administrative computer systems.

Central to this goal are mechanisms which prompt initiation of jobs ready to be run, facilitate automatic restart of aborted jobs, and delay initiation of downstream jobs whose inputs or master files are not yet ready for processing.

The system runs on an IBM 360/67 under TSS.

INTRODUCTION

Administrative systems are expensive to design, expensive to implement, and expensive to maintain. It is not surprising, therefore, to find the literature rife with papers on structured analysis, the analyst-user relationship, structured programming, top down design, team programming, and other techniques whose goals are to reduce these substantial costs.

Another cost, about which little has been said, is the necessary cost of running these systems in real world production mode. Like maintenance it is ongoing and more expensive than generally realized. In addition to the obvious costs of machine time, data entry, and salaries of regular production personnel there can be large costs associated with system failure during production runs. These come about due to delay and the effort expended to overcome the delay. The interest on delayed income from student bills, development, and research contract expense recovery can amount to several thousand dollars a day. When payroll systems get behind schedule it is not unusual to find several top systems analysts and programmers putting in considerable overtime. The cost of foregone production is real and can be large if it happens frequently. The cost of delay in getting timely reports to management is difficult to assess, but can produce large secondary expenses in addition to delaying important management decisions.

Information is a purchased resource just like material and labor. We buy it because it hopefully contributes to the quality of our product; subject to this quality we try to minimize its cost.

UCS (User Control System) was designed to prevent administrative system failures and their ensuing delays, and to speed up recovery from overall system failures of any kind.

Equally as important as these functional aspirations was the desire to make this system truly easy to use by the personnel assigned to running production of any administrative system. The dataset LOG.BATCH contains a record of all jobs queued, started, terminated, and successfully completed in chronological order. The user can determine very easily from this log which jobs ran successfully and which jobs will have to be restarted or rerun. Appendix E is a copy of the instructions for daily use of UCS in running production. A call of procedure B-JOBS produces a list of jobs remaining to be done along with date due and inputs required. Procedure B-RUN is then called to automatically generate and queue those jobs due to be run. Special requests and one of a kind jobs are generated with the procedure B-DS and queued with B-XEC.

We have been using this control system to run accounting and payroll production for three years. Many basic features and improvements were added during the first two years as a result of much hands on experience. Few changes have been made in the last year.

UCS is implemented on an IBM 360/67 running under IBM's time sharing system TSS. It is a procedure call language written in BAL, COBOL, and the TSS command language. Appendix A contains all of the UCS procedures for users.

The variables in Appendix B are used for communication within and between jobs. The logs in Appendix D are datasets used to keep track of overall system and individual job progress.

OVERVIEW

UCS is batch oriented but was written to accomodate conversational jobs. This was done to take advantage of on-line debugging facilities and to make restarting of aborted jobs simpler. The COBOL application programs, their control procedures (JCL) written in TSS, and UCS itself can all be debugged conversationally. This made it relatively easy to debug UCS once it was turning over.

There are three distinct stages to bringing up UCS on an existing administrative system such as accounting or payroll:

Stage-1
Batch job generation, queuing, and logging facilities are made available.

Stage-2
System control procedures (JCL) are examined, critical areas identified, and restart blocks established.

Stage-3
Job precedence constraints, input data relationships, and production schedule requirements are specified.

These stages provide a convenient natural partitioning of the major UCS funtions and capabilities.

STAGE-1.

A "bootstrap" program copied into the host system is used to implant the entire user control system. This is done interactively in order to simplify the resolution of procedure name conflicts. The whole process including activating stage-1 capabilities takes about an hour.

Batch jobs are now generated by calling the UCS procedure B-DS with the single parameter "Jobname". This is the name you want the job called -- e.g. NOV78.SALARY.PAY.CALCULATION. Parameters are usually supplied conversationally, but may also be taken from a designated dataset or directly from another batch job. Appendix C shows the batch dataset format for all batch jobs. Note that the TSS command LOGON has a parameter called Restart; if Restart=Yes the TSS operating system will automatically restart this job from the beginning if a system crash occurs before the job terminates. In stage-1 we run all but the most trivial jobs with Restart=No.

The job is queued to await its turn for execution by calling the procedure B-XEC. A message that the job has been queued is put into LOG.BATCH (Appendix D). When its turn to execute comes, the operating system logs it on via the LOGON command. Control then passes to B-PRO (again referring to Appendix C) which immediately puts the message "started" into LOG.BATCH. The two parameters Job-In-D and Job-Out-D are associated with job dependency and used to test and set the variable SCRAM (Appendix B). If this job depends on the successful completion of previous jobs, then Job-In-D has the value TRUE. In this case B-PRO will terminate the job if the current value of SCRAM is not 0; SCRAM is a variable used to tell UCS that some previous job did not successfully terminate. The second parameter Job-Out-D is given the value TRUE if some future job depends on this job. In that case if this job does not finish normally, SCRAM will be incremented by 1 to warn that future job not to start.

B-PRO also checks to make sure the current job does not have the same name as the last job run. If it does B-PRO calls B-LOGOFF with the message "Job Just Ran" and the job is terminated. This prevents a job caught in a crash during normal logoff from needlessly restarting. B-PRO next sets the variable RUNNING to TRUE and sends a message to warn any conversational user of this particular administrative system that a batch job is starting. This prevents software collisions between batch and conversational jobs running at the same time. Under UCS we restrict execution to one batch job at a time for a given system.

It is the responsibility of the conversational user not to modify files or procedures that the batch job may be using.

The next commands to be executed are those supplied by the user to control the execution of his programs. If the programs abort due to conditions detected by the operating system or computer hardware, control passes to the UCS procedure B-ABEND. The operating system was told to do this by a command executed in B-PRO. B-ABEND displays the reason for the abort if possible, as well as other information selected to aid debugging. The message "Job Aborted" is sent to any conversational user and the special delivery mailbox where it will be displayed to the next conversational user. If Job-Out-D is TRUE for this aborted job the variable SCRAM is incremented by 1. B-LOGOFF is then called with the message "Job Aborted", which is put into the dataset LOG.BATCH. If SCRAM is not 0 the computer operator is sent a message asking him to hold all batch jobs in the queue for this user. This prevents jobs in the batch queue from executing, but permits them to hold their place in line. If the operator fails to do the hold, downstream jobs with Job-In-D = TRUE will detect SCRAM not equal 0 and they will terminate without execution. If the variable CALL is TRUE the operator is sent another message asking him to call the user. This message contains the user's name and telephone number, jobname, and abort condition. The variable RUNNING is then set to FALSE so subsequent jobs won't think this job is still in execution.

Usually the programs terminate normally and B-LOGOFF is executed by "falling through" with the message "Finished Successfully" hardwired as a parameter. This messsage is placed in LOG.BATCH along with the date, time and jobname. The job is then logged off the computer system.

STAGE-2

This stage is concerned with establishing automatic restart capabilities so that jobs may be queued with Restart = Yes. A systems analyst familiar with the system and its programs must be involved here.

The systems control structure is divided into critical and non critical blocks. A critical block is a sequence of job control statements that cannot be restarted once entered without some outside help to restore initial conditions. Updating of master files in place, erasing of files, and renaming of files tend to produce critical sequences. Most critical blocks can be rewritten to make them non critical; e.g. update copies of master files rather than the master files themselves. Rewriting critical blocks to reduce execution time in these areas correspondingly reduces the probability that a system crash will take place in a non restartable part of the user's system. We have made no attempts, however, to rewrite any COBOL application programs for purposes of getting a better fit with the user control system.

Each critical block is now prefixed with a call to the UCS procedure B-SCRAM-INC, and suffixed with a call to B-SCRAM-DEC:

```
"Block5"
    B-SCRAM-INC  "Entering critical Block5"
    Body of Block5
    B-SCRAM-DEC  "Exiting critical Block5"
```

This is done in all procedures and subprocedures at all levels. If the job terminates for any reason within Block5, SCRAM is guaranteed to be greater than 0. If this job is restarted B-PRO will detect SCRAM > 0 and by examining LOG.SCRAM will know that this job previously did the incrementing; the job will then be terminated.

Each non critical block is prefixed with a call to the USC procedure B-ENTER, and suffixed with a call to B-EXIT:

```
"Block7"
    B-ENTER  "Entering restart Block7"
    Body of Block7
    B-EXIT   "Exiting restart Block7"
```

If a job terminates for any reason within Block7, it may be restarted at the beginning of Block7. B-ENTER sets a local variable to the value "Block7-Start"; B-Exit sets it to "Block7-Done". Upon restarting, the outermost control procedure passes control to the start of the last block that did not terminate.

Automatic restart is currently restricted to the outermost procedure. There is some loss of CPU time on jobs that could have been restarted at a lower level, but this works well on the cases most frequently encountered. Automatic restart at lower levels starts to require a lot of overhead to solve intersecting sub-procedure pathway problems and to maintain flagged execution detail stacks. We are able to get sufficiently fine restart resolution by careful selection of procedure calls in the outermost procedure alone. Manual restart, when it is necessary, can be and should be done at the lowest level. This takes advantage of almost all the computational progress the job made, and loses only the work done in the last block prior to failure.

STAGE-3.

In this final stage we turn our attention to the production schedule, the input that each job requires, and the order in which jobs must run because of their input requirements.

The dataset LOG.JOBS.TO.DO must be built initially from existing production schedule and job input information. It will contain a list of jobs to be run for the current period. Each job has an associated sublist containing:

1. Date job should be run
2. Date output from job is due
3. Names of inputs required
4. Status of inputs (see LOG.INPUTS appendix D)
5. Jobs which ~~which~~ produce input for this job

6. Jobs which depend on this job for their input

This now becomes the production schedule for UCS which maintains it and LOG.JOBS.DONE. The UCS procedure B-NEW-P is used to generate a new LOG.JOBS.TO.DO at the start of each new time period (Week, month, semester....).

When the user is ready to run production he calls the UCS procedure B-JOBS which uses the logs to produce a list of jobs to run with date due and inputs required to run each job. After making sure all inputs are ready or will be ready by the time the job starts, B-RUN is called to generate and queue the jobs selected for execution at this time. B-RUN makes further checks to insure that the job is in LOG.JOBS.TO.DO, not in LOG.JOBS.DONE, all precursor jobs have run or are in the queue, no successor jobs have yet been run, input is ready, and job is valid for current period. If suspicious conditions are found, error messages are displayed at the terminal or sent to LOG.BATCH. If no errors are found a batch dataset is generated and the job queued.

The proper selection of names for input datasets and jobnames is one of the most important tasks in bringing this stage up to full capacity. UCS is name driven from LOG.INPUTS, LOG.JOBS.TO.DO, and LOG.JOBS.DONE.

The capabilities of stage-3 are very effective in helping the user get the right job queued at the right time, and preventing jobs that should not yet be run from getting into the execution phase.

CONCLUSION

We have found UCS effective in preventing user mistakes in the following problem areas:

Data.

1. Missing
2. From wrong period

Production.

1. Jobs running before or after they should
2. Jobs not run
3. Jobs running on wrong input
4. Jobs running successfully but no output

UCS speeds up recovery from failure due to system crashes in the following ways:

1. Provides automatic restart capability. All accounting jobs run with RESTART=Yes.
2. Prevents crashed jobs that have essentially completed successfully from restarting.
3. Provides minimal intervention restart and total restart from backup capability by providing detailed information on how and where to restart jobs.

The main system log, LOG.BATCH, provides a concise summary of period production activity. This is very useful if the system has to be "set back" to some early processing stage due to bad input or loss of master files.

Since UCS does the detailed work of generating jobs and keeping track of their progress, it is much easier to learn how to run production as well as to actually run it. It has been even easy for us to take a system back and run it ourselves when circumstances have demanded.

Appendix A. Basic UCS Procedures.

These procedures are written in BAL, COBOL, and the TSS command language. They can be called by the user, UCS, or any other procedure.

B-ABEND Process aborted jobs prior to logoff.

Display reason for abort if possible. If conversational job return control to terminal. Send message to conversational job (if any). Display selected parameters for debugging:

time, space, usage, program stack, error stack

If in loop (i.e. within UCS) display message and logoff. Check Job-out dependency and increment SCRAM count using B-SCRAM if required.

Call B-LOGOFF.

B-CANCEL Cancel a job.

Job may be executing or only waiting in queue.

Update LOG.BATCH using B-UPDT-LOG.

B-CLEAN-UP Cleanup the system.

Cleans up and resets all UCS variables to normal values.

D-DS Generate a dataset for use as a batch job.

Job parameters can be supplied in 3 ways:

1. Conversationally from terminal
2. Directly from a batch job in execution
3. Indirectly from a designated dataset

If conversational set BATCHXDS = name of this job.

If JOBID not self set up to get password from other ID.

Dataset may be listed at this time without disclosing the password. Unhash the password and put it in the LOGON command string.

Close the batch job dataset.

B-ENTER Block enter.

Initializes restart block variables. Must be first procedure in restart block. Called with this block name as a parameter. If system crashes UCS can restart program at start of this block.

B-EXIT Block exit.

Sets values of block variables so that UCS knows this block was exited. Must be last procedure executed.

B-JOBS List jobs.

Display at the terminal a list of jobs remaining to be run for the current period and a list of jobs already successfully completed.

For each job yet to be run a sublist of inputs with their generator and status attributes (see LOG.INPUTS in Appendix C) is included. Output may also be listed on the line printer or displayed on the sysout for batch jobs.

B-LOGOFF Logoff a batch job.

All jobs execute this procedure as their last command. B-DS enters this command for every batch job it generates. Set NOLOOP and RUNNING to FALSE.

Update LOG.BATCH with type of logoff:

1. Finished successfully
2. Aborted due to: no input/no space/out of time/etc.
3. Scramed (SCRAM > 0 AND job-in dependency exists)
4. Job just ran (Last job to run had this name)

Send message to converstional user (if any). Decrement SCRAM if requested by parameter to call. Update LOG.JOBS.DONE and LOG.JOBS.TO.DO. If SCRAM > 0 hold all batch jobs until further notice. This prevents downstream batch jobs from executing but retains their place in the work queue.

Log job off.

B-MAILSPD Mail special delivery.

Put a message in the "special delivery mailbox". Used for urgent messages to user. These messages are displayed prominently on the terminal every time the user logs on. They continue to be displayed until the user removes them.

B-NEW-P New period initialization

Executed by user when current period is complete. Check is made to make sure LOG.JOBS.TO.DO is empty. Generate a new LOG.JOBS.TO.DO and flush out LOG.JOBS.DONE. Generate a new LOG.INPUTS.

B-PRO Batch prologue.

All jobs execute this procedure as their first command. B-DS enters this command string with appropriate parameters whenever a batch is generated. Set NOLOOP=TRUE and JOB=ID of initiator of this job. Set BATCHXDS=name of this job. Update LOG.BATCH with message this job is starting. Send message to conversational user (if any). Check if job just ran using procedure B-RAN. If SCRAM > 0 AND job-in dependency exists log the job off using procedure B-LOGOFF.

B-PRT Print.

Queue a print and update LOG.BATCH with the message that a print has been queued.

B-RAN Check name of job that just ran.

If job that just ran has same name as current job, call B-LOGOFF with message "Job Just Ran". Used primarily to avoid restart of a job caught near or during logoff due to a system crash. Normally do not run two jobs back to back with the same name.

R-RUN Run a job.

This is the highest level procedure in the system. It is usually called with the name of the job to be run as the only parameter. The following checks are made before the batch dataset is created and executed:

1. Must be in LOG.JOBS.TO.DO
2. Must not be in LOG.JOBS.DONE.
3. All precursor jobs must have run successfully.
4. No job for which this job is a precursor must have been run.
5. All input must be ready. If input belongs to another user a copy is made for sole use of this job.
6. Special switches (if any) for this job must all have the value TRUE.
7. Job must be valid for this period.
   E.G. Student billing is normally run only in the middle of July and November.

All of the above are checked and appropriate error messages (if any) are put in LOG.BATCH. If there are any errors the current job is terminated. The procedure B-DS is called to generate the batch dataset and B-XEC to execute it.

B-SCRAM-DEC Decrement SCRAM by 1.

Decrement SCRAM and update LOG.SCRAM.

Used by both UCS and user procedures upon exiting a critical procedure area so job can automatically restart if required.

B-SCRAM-INC Increment SCRAM by 1.

Increment SCRAM and udate LOG.SCRAM.

Used by both UCS and user procedures upon entering a critical procedure area to prevent automatic restart.

B-UPDT-LOG Update a log.

The name of the log to be updated, USERID of job initiator, message, and comments are passed as parameters. If this job was initiated by user A to run under user B then the logs of both A and B will be updated. Used by both UCS and user procedures to put messages in the various logs.

B-XEC Execute a job.

Puts a job into the batch work queue to await its turn for execution. Update LOG.BATCH with message "Queued". Used by all UCS and user procedures to queue jobs to run in batch.

Appendix B. UCS Variables.

BATCH
True if batch job, else false.

BATCHXDS
Name of current or last batch job.

B-COMMENT
Current comment if any. Set to null after use.

B-MSG
Current message.

CALL
True if user wants to be called if job terminates in some designated way, else false.

CONVERSE
True if conversational job, else false.

JOB-IN-D
True if job is dependent upon other jobs for input or master file update, else false.

JOB-OUT-D
True if this job is precursor of jobs yet to run, else false.

NOLOOP
True if B-LOGOFF not called, else false. Used to prevent looping through B-LOGOFF.

RUNNING
True if a batch job is running (in execution), else false. Used to prevent software collisions between batch and conversational jobs running at the same time.

SCRAM
Takes values 0 though 9. SCRAM > 0 implies some critical procedure area has been entered but not exited. Used by both UCS and user procedures to indicate level of critical area penetration. Prevents subsequent jobs from starting if they depend on successful termination of job incrementing this variable. LOG.SCRAM is updated every time SCRAM changes.

Appendix C.

All batch datasets are generated by B-DS and have the following format:

```
LOGON  Userid,Password,Account,Time,Restart
B-PRO  Jobname,Initiator,Job-In-D,Job-Out-D
User commands and program calls (any number)
B-LOGOFF  Jobname,"Finished Successfully"
```

LOGON is a TSS command that logs the job into the execution phase.

B-PRO is a UCS procedure that does checking and initialization.

User commands and program calls are provided by the user to run the programs needed for this job. The UCS procedure B-RUN automatically generates these calls and commands.

B-LOGOFF is a UCS procedure for logging off jobs upon completion.

Appendix D. UCS Logs.

LOG.BATCH

Main system log. Contains record of all queues, starts, prints, terminations. The user is encouraged to add comments at anytime using B-UPDT-LOG. This log provides an easily read summary of all important system activity.

LOG.CONVERSATIONAL

Record of logon and logoff for conversational users. Used to keep track of who has been using the system.

LOG.INPUTS

Record of input datasets for all jobs in the system. Each input dataset has two attributes:

1. Generator (Where this input comes from)
    - Job in this system
    - Job in another system
    - Manual creation
    - Input created outside the university
2. Status
    - Ready for use
    - Incomplete
    - Does not yet exist
    - Already processed

LOG.JOBS.DONE

Record of jobs successfully completed during current period. Used by user to track system progress and by UCS to check job dependencies.

LOG.JOBS.TO.DO

Record of jobs remaining to be run for current period. Each job has a sublist containing the date job should be queued, date output is due, inputs required, status of inputs, jobs providing input for this job and jobs depending on this job for input. Used by user to schedule remaining production and by UCS to check job dependencies.

LOG.SCRAM

Record of events causing SCRAM to change value. Very useful for tracing progress of jobs that abort in unexpected and unusual ways.

Entries in all the above logs are time-date stamped and contain the name of the job making the entry. UCS updates and maintains all of the logs. In addition the user may enter information and comments into LOG.BATCH.

Appendix E. Instructions for Daily Use of UCS.

1. Logon ~~on~~ to computer.
2. Review LOG.BATCH for disposition of previously queued jobs.
3. If any jobs from step 2 need restarting, restart them.
4. Check output from step 2 jobs for completeness and correctness. Rerun any jobs necessary to obtain complete and correct output.
5. Call the procedure B-JOBS to get list of jobs to do today.
6. Check to make sure input is ready or will be ready when job runs.
7. Call the procedure B-RUN to generate and queue jobs ready for execution.
8. Log off computer.

USE OF REQUEST FOR PROPOSALS FOR SOFTWARE PURCHASE SELECTION

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This paper will discuss an alternative to the normal detail bid specifications usually required to purchase software by public institutions of higher education. The Request for Proposal method offers the institution an opportunity to become involved with software vendors at an early point in the project, and through proper evaluation, a better understanding of individual software vendor's products.

USE OF REQUEST FOR PROPOSALS
FOR SOFTWARE PURCHASE SELECTION

The University of Missouri has followed a general trend toward purchasing commercial software to fulfill new system requirements. The purpose of this paper is to discuss our experiences in the evaluation and selection of a financial software product using the Request for Proposal (RFP) procedure.

Most public institutions of higher education have a public disclosure responsibility requiring them to advertise for all significant purchases. This requirement is usually met by advertising for bids for the desired product. The RFP method is a simple change in procedure. Its purpose is to obtain detailed information about software availability and performance at an earlier point in the project than permitted by the bid procedure. A comparison of the two shows the bid process has these disadvantages:

- Formal relationship with vendors is not established until the detail specifications have been written and the bid responses received. Until this relationship is established, communications with the vendor may be nothing more than product presentations. The level does vary according to the marketing practices followed by the various vendors but rarely provides sufficient knowledge to build from.

- Detail bid specifications must be written following the completion of the system specifications.

- Approval of the bid specifications by the Purchasing department (and perhaps the university legal office) usually requires several iterations.

- Bid evaluations and the subsequent award require time and resources that can be better utilized in direct project activities. It is not unusual for three months or more to be consumed in this process, starting with writing detail bid specifications and ending with the bid responses.

- Results of the bid evaluation can be shocking. You may find no vendor meets the specifications you labored so hard to produce. This development could require that you repeat the entire process; or you may need to convince your legal staff and the responding vendors that compromises are in order.

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- Low bid is frequently not the best bid. The dollars saved in the initial low bid software purchase may be lost many times over for several reasons. Although the system may not be the best for the institution, it may be difficult to convince the university administrators of this fact in light of the low bid atmosphere.

The Request for Proposal method of purchasing software offers several advantages over the bid process.

- At an early point in the project, you should have a good grasp of the broad, general requirements of the new system. These will assist in the preparation of an RFP seeking proposals from those vendors having potential to supply the software. These proposals establish a formal relationship with the vendors, and make their product details more accessible.

- Advertising of the RFP will normally meet the requirements of public disclosure.

- Extended length of time for evaluation. Using the RFP early in the project provides an opportunity to thoroughly examine the capabilities of the vendor software in a variety of ways. Additionally, you have a longer period of time to become acquainted with the vendors and to evaluate their competence and customer satisfaction.

- System requirements evolve with better knowledge of available software to fulfill those requirements. The RFP provides an opportunity to learn in detail the capabilities of the vendor packages while defining the detailed systems requirements. When purchasing software, it is reasonable to define system requirements in terms of the available software to support them. This prevents the situation previously mentioned when bid responses do not fulfill the expectations of system requirements.
  If the evaluation of the software products proceeds simultaneously with the detailed system specifications activities, you should arrive at a point where you have your detail system specifications in one hand and in the other, a detailed knowledge of the vendor products available to support those requirements. This should make the software selection a natural part of the process.

Early knowledge about vendor product capabilities provided by the RFP procedure suggests an early start of software evaluation.

- One of the initial activities to evaluate software may consist of arranging vendor software marketing presentations. Ideally, these presentations should be made to the project team, any others involved in your project management structure, and as many functional users as possible. This serves two purposes: it provides an opportunity to start becoming acquainted with the vendor and the project; and it also demonstrates to the university community that visible activities are taking place related to the implementation of a new system.

- Make site visits to other institutions. During the vendor presentations, obtain the names of other institutions of similar size and organization that are current system users. Make site visits to at least one institutional user of each vendor's system being considered. During these visits, talk to as many people as possible. Get the views of the functional users, senior administrators, project directors, and computer center directors. Require each site visit team member to write a detailed report of their observations.

It is important that this be done immediately following each visit while the facts are still fresh.

- In addition to the site visits, telephone and written contacts should be made with other institutions that have been listed as users of the system you are reviewing. Results of these contacts should also be documented.

- A visit to the vendor home office will give you a better appreciation of the capability of the vendor. Many times when contact has only been with one or two vendor representatives, a true measure of the vendor's capabilities cannot be determined. During visits to vendor home offices, talk to as many people connected with their development activities as possible, and with the corporate president or vice president for development. From this you should gain a better knowledge about the vendor's capability to fulfill the committments stated in their proposals.

- As a part of the response to the RFP, each vendor should be required to submit for examination the program code for the major programs in the system, along with samples of programming documentation, systems documentation, user documentation, and operations documentation. Non-disclosure agreements may have to be signed with the vendor regarding these items.

- Before examining the evaluation procedure, a look at the three-level project management structure used by the University of Missouri for financial systems development may be beneficial. The first level is the Project Team, which has the overall responsibility for the development and implementation of each system. The second level is a campus-based steering committee. Membership is middle management having a good functional knowledge about the area planned for implementation. Project team representation on the steering committee is also desirable. The third level is the policy making group, and consists of the Vice President for Administrative Affairs, the senior Business Administrator from each of the campuses, and selected Assistant Vice Presidents. This structure encourages campus participation in the project, and helps keep senior administration abreast of project activities. The membership of the first two levels of this structure along with selected functional users can effectively be involved in graded evaluations of software.

Prior to the graded evaluation, each vendor should be given a list of questions to which they will verbally respond during the evaluation. These questions can be grouped in three major categories covering System Functions, Installation Procedures and Hardware/Software Compatability. Prior to the evaluation the Project Team should assign a weight to each question based on its importance to the system. Each evaluator is given a score sheet containing the question number and a ranking of "0" through "5", zero indicating the function was not available, and five that the vendor software has an excellent capability to manage that activity or function.

After evaluations have been finished, a composite score by vendor for the entire evaluation, scoring by the functional areas represented, and scoring by the major system functions can be prepared. This evaluation is a valuable tool in the selection of software. It identifies the vendor having the best overall capability to respond to the system needs as viewed by the evaluators.

Institutions that have not previously used the RFP may have a selling job to do with purchasing and legal offices. This becomes necessary in order to get them to accept the RFP concept and understand its differences from a traditional Request for Bid. Success in getting the University administration to accept the RFP may involve getting senior administrators, Legal Council and Purchasing officials all in the same room for a discussion of procedure. As persuasion draw an analogy between the RFP for software purchase and the selection of an architect to design a new building. In the selection of an architect, you advertise for Requests for Proposals relating to the architect's competence in designing a building after providing broad specifications. Then you select the architect based on demonstrated capabilities. You do not hire an architect after the building has been designed.

You cannot stop after the initial success in gaining approval to use the RFP procedure. When ready to select the successful software vendor, remind the purchasing office that software selection as a result of the RFP is different from a bid award. Estimated costs for a new system as indicated on the vendor's responses to the RFP cannot be used in the same way as amounts on bid responses. This must be made clear when making a selection recommendation to the administration and governing board of your institution.

In conclusion, the benefits provided by the RFP from the establishment of a formal relationship with software vendors during the systems definition phase provide an opportunity to evaluate software and vendors over a longer period of time. We believe these and other advantages of the RFP make it worthy of consideration for use in the purchase of software.

TASK MANAGEMENT FOR FIREFIGHTERS:
A PRACTICAL APPROACH TO TASK MANAGEMENT

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Task Management For Firefighters: A Practical Approach To Task Management

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The project management system which this paper describes is of particular value to project managers who have a limited amount of time for planning. The reports which are described were specifically designed to represent a multi-application environment (Accounting, Admissions, Library, Payroll, Student Records, etc.). The reports show at a glance a clear picture of work in progress, work awaiting assignment, and completed projects by application. The system also provides a simple mechanism for status reporting by the individuals involved in each project. The discussion of this system includes practical solutions to deciding project priorities, determining time estimates, creating positive peer pressure among the programming staff, and formalizing requests for services from the users.

This project management system offers a realistic approach to organizing requests from multiple departments and controlling the workload of the development/maintenance computer group.

The proliferation of computers has extended to effect practically all walks of life. The things that can be accomplished with a computer boggle the mind, even without considering electronically how the magic is really done. Behind the mystery there are people who have some basic skills, the main skill being logical thinking. The managers who supervise the magicians have the need for basic managerial skills universal to all disciplines. The skill of project management is necessary in order to control a project(s). However project management is not a unique skill or problem to data processing. What then are the difficulties and solutions to project management in the computer department?

This paper will focus on task management instead of project management. For the purpose of this discussion task management will mean the management of multiple projects or tasks (requested, in progress, in hold, and completed). Project management being the management of a single project or task. The discussion is based upon the premise that unless a strong task management system is being used to control all tasks, there will rarely be time to monitor individual projects in detail. Therefore it is necessary to bring the environment under control while attempting to control the individual systems which must flourish in that environment.

The computer department must service a multiple constituency. Numerous tasks are being researched, designed, programmed, tested, and implemented simultaneously. There are multiple sources of task requests. As with any service oriented group, priorities must be established deciding which tasks are assigned for work and which tasks will be held pending completion of others. A service group can expect to be criticized by its clients who are waiting for service unless the clients can participate in the priority assignment process. The question now becomes one of equitable service to all constituents.

One important realization that emphasizes the need for a good task management system is that the number of task requests will never reach zero and probably will increase rather than decrease. The longer a computer exists in an organization the greater the number of people who will become familiar with it and consequently the greater the number of ideas (tasks) that will be generated. Once an information system is conceived and implemented there will always be new improvements and additions to the system. These phenomena lead to an axiom that the longer a computer department has been in existence the more tasks that will be requested. The issue now becomes one of tracking an increasing number of tasks without consuming or wasting valuable staff resources.

It must be recognized that there is a finite quantity of man-hours available from the computer group. This recognition of a limited resource is imperative to the user as well as the computer group management. A formal task requesting procedure is the initial key in reducing chaos between the user and the computer group. Task Requests should originate from the concerned user department. In some cases an idea for system improvement is conceived within the computer group. In this case the Task Request is still generated, most likely by the computer group, but approved by the department whose system will be modified.

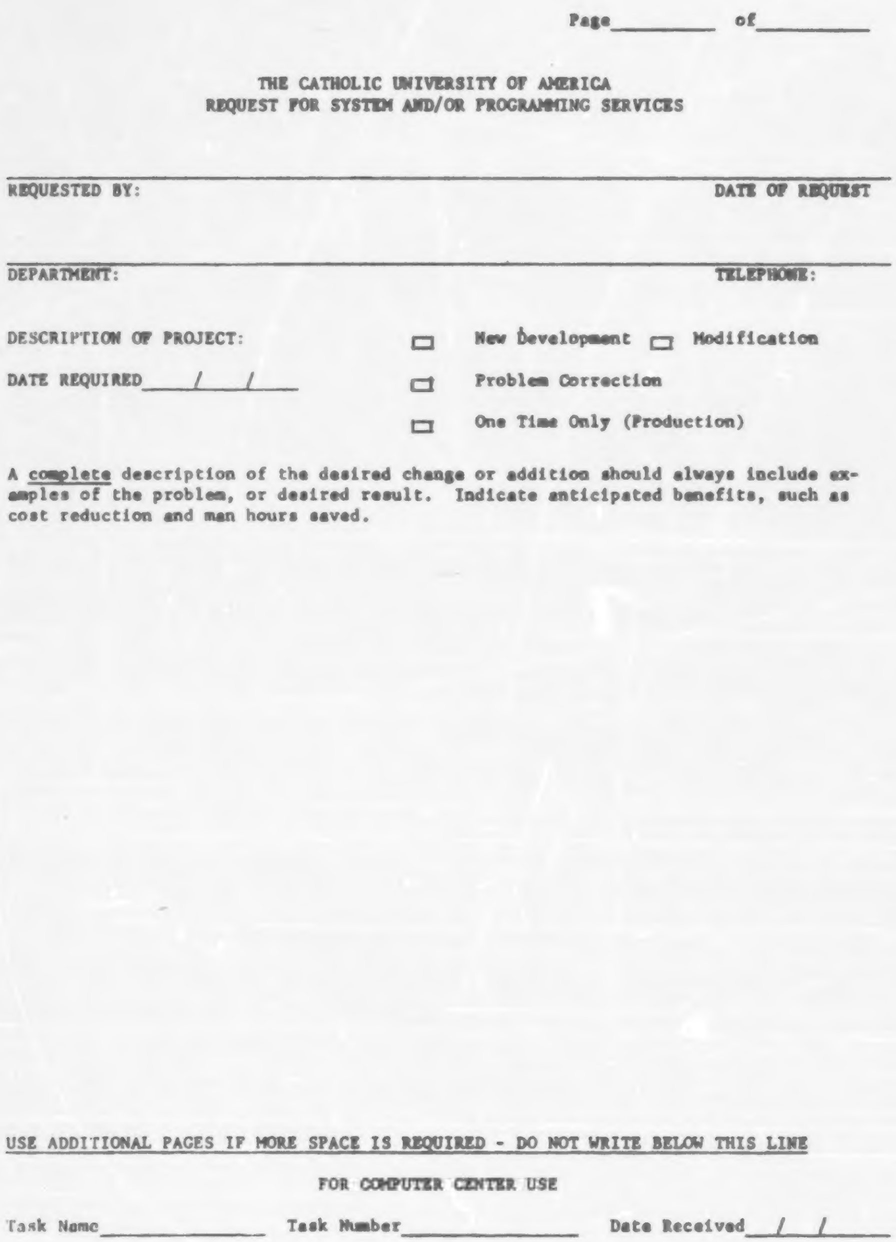
There are two main objectives in having a task request procedure. The first objective is to force the users to appreciate that each change, new development, and/or inquiry takes time to research and implement. This realization will allow scheduling of projects and provide adequate time for analysis, documentation, programming, and testing. The nature of the computer group is one of being service oriented, not existing for its own needs. One of the inherent problems of serving multiple constituents is the difficulty in orchestrating equal service to all. The problem is further complicated by the common view of the user that the service group exists solely for his own department. The second objective is to encourage the users to review their own problems before calling the computer group. This objective is further strengthened when many users realize that their departmental problems can be solved without the involvement of the computer group. When a task is received and determined not to be of catastrophic urgency it will be put on the hold list. All too often problems are investigated determining non-computer oriented difficulties, which might have been solved by the user instead of waiting for the computer group's help.

Task Requests are submitted to a central person in the computer group. This person should be responsible for work assignments within the computer group. A brief discussion should take place between the authorizing user and the central computer group leader. Any necessary clarifications should be made to determine the nature of the request, the absolute value, the urgency, and an initial assessment of the scope of the request. Since this is an official review, all fruitless tasks will be rejected.

Requests made by a department or group outside of the department which has responsibility for a system are referred back to the responsible department for submission. Accepting tasks from only the responsible department subtracts man-power resources from the responsible department's allowance on an official basis. This limits the number of constituents being serviced.

A Task Request is only intended to deal with maintenance or development of systems. Figure (1) is a sample of a Task Request.

The Task Request is used to request programming and/or analysis work (program maintenance or development). There is a separate Workorder requesting procedure used to execute the functional parts of a system which already exist and operate satisfactorily. These jobs have been programmed, tested, documented, and produce results in a set format(s) dependent upon parameters supplied at run time. Therefore there is no need for



Page________ of________

THE CATHOLIC UNIVERSITY OF AMERICA
REQUEST FOR SYSTEM AND/OR PROGRAMMING SERVICES

REQUESTED BY: DATE OF REQUEST

DEPARTMENT: TELEPHONE:

DESCRIPTION OF PROJECT: ☐ New Development ☐ Modification

DATE REQUIRED____/___/____ ☐ Problem Correction

☐ One Time Only (Production)

A complete description of the desired change or addition should always include examples of the problem, or desired result. Indicate anticipated benefits, such as cost reduction and man hours saved.

USE ADDITIONAL PAGES IF MORE SPACE IS REQUIRED - DO NOT WRITE BELOW THIS LINE

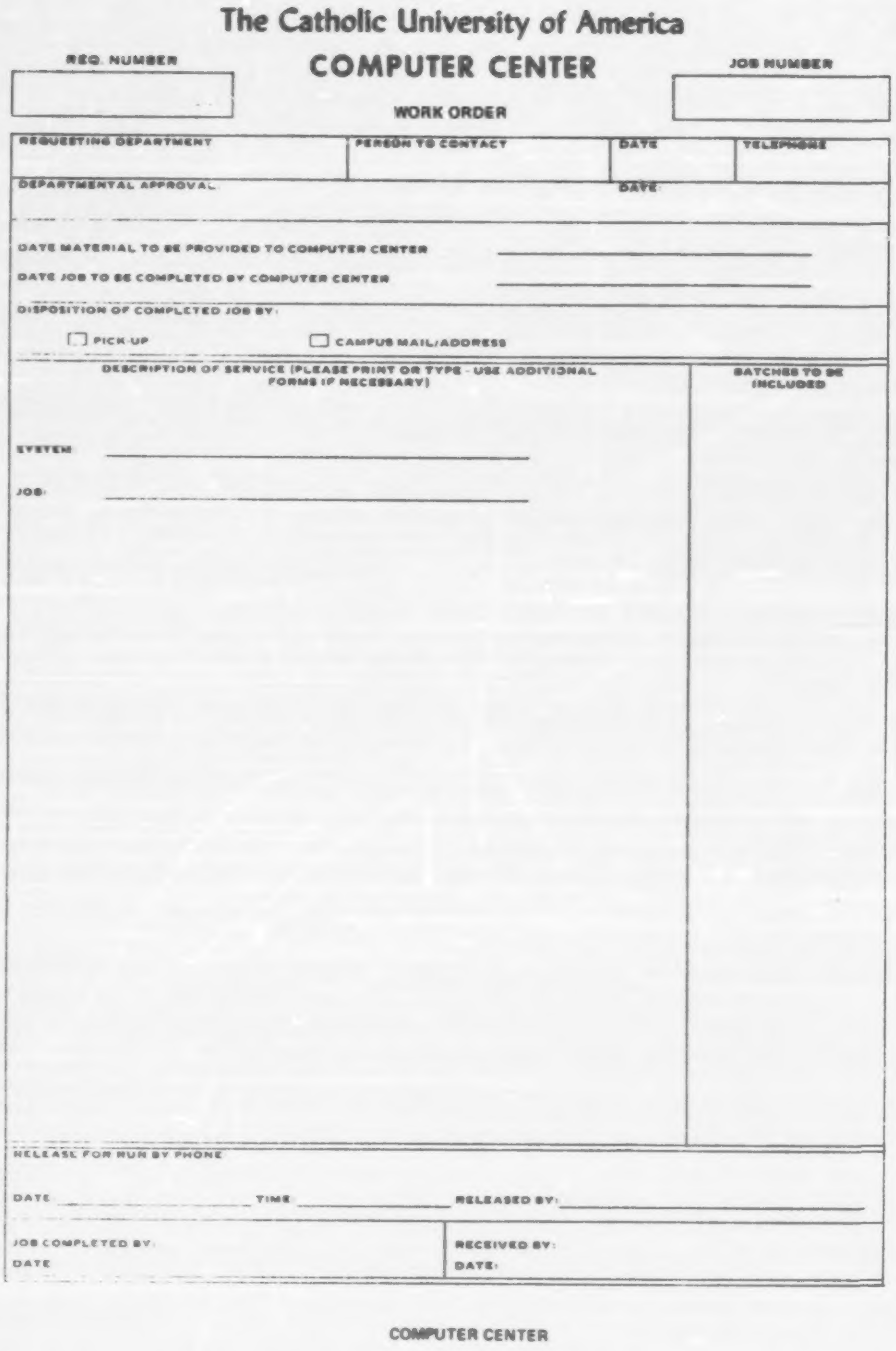
FOR COMPUTER CENTER USE

Task Name__________ Task Number__________ Date Received___/___/____

Figure (1)

a programmer to be involved in the production or execution of these jobs. As part of the documentation the user is supplied with the questions that must be answered in order to generate the parameters for each job. Once the user is in control of supplying the parameters to his jobs the remaining question is timing. The formal requesting procedure is for the user to supply a Workorder which indicates the parameters to be used, when to run the job, and when the results are needed.

All too often the user department does not view the computer system as part of their departmental responsibilities even though they have tremendous dependency on the computer system. Requiring a Workorder to be submitted by the user to production control at the computer center has several benefits. Because the user supplies the parameters there is a direct involvement in the use of the computer system. This in turn leads to a basic understanding of the computer system which in itself will help prevent misunderstandings between the user and the computer center. The users will feel that the computer system is part of their responsibility. When a job is turned over to production control from the programming group the programmers will be left to do programming. Since the user is now an active part of the system the basis for scheduling of jobs has been established. Figure (2) is a sample of a Workorder used to request production computer jobs.



The Catholic University of America

REQ. NUMBER

COMPUTER CENTER

JOB NUMBER

WORK ORDER

REQUESTING DEPARTMENT	PERSON TO CONTACT	DATE	TELEPHONE
DEPARTMENTAL APPROVAL		DATE:	

DATE MATERIAL TO BE PROVIDED TO COMPUTER CENTER ____________

DATE JOB TO BE COMPLETED BY COMPUTER CENTER ____________

DISPOSITION OF COMPLETED JOB BY:

☐ PICK-UP ☐ CAMPUS MAIL/ADDRESS

DESCRIPTION OF SERVICE (PLEASE PRINT OR TYPE - USE ADDITIONAL FORMS IF NECESSARY)

BATCHES TO BE INCLUDED

SYSTEM: ____________

JOB: ____________

RELEASE FOR RUN BY PHONE

DATE: ____________ TIME: ____________ RELEASED BY: ____________

JOB COMPLETED BY: DATE	RECEIVED BY: DATE:

COMPUTER CENTER

Figure (2)

The first major phase in the life of a task is to determine the amount of manpower required to do the project. The total project estimate includes time for analysis, programming, testing, and implementation. The analysis time estimate includes time for investigation and the writing of specifications. Accepting the fact that there rarely is time to document properly at the close of a project, the reasonable solution is to require that specifications be prepared in the format of documentation. The most commonly considered portion of project time is programming. All too often there is inadequate time provided or used to fully test new systems or changes to existing systems. The old axiom that there is always time to redo something out of necessity, but seldom time to do it right the first time, lives next door to Murphy's Law. The time involved in the creation of test data is a major consideration and directly effects a system's reliability. A certain amount of time is needed to implement a change to a system. This time element takes into consideration converting from test files to production files, final documentation clean-up, the replacement of modified programs in the central library, and turning over the operation to production control.

The philosophy of project estimation is a noble one, but rarely are there awards given for accuracy. The basic needs for sensible estimation are a guideline/worksheet and some involvement on the part of the people doing the work. The guideline must contain a list of each program and procedure involved in the change/development. For each item, estimates of analysis, programming, testing, and implementation are given. The need for involvement of the people doing the work in estimating project duration is, simply, the more factors known to effect the project the better. When the deadline arrives any antagonism toward the people who established the deadline will be very limited if the people doing the work were involved in establishing their own deadlines. Figure (3) is a sample of a Project Estimation Worksheet.

The assignment of a task to a specific programmer(s) includes the need to provide and receive certain administrative information. The Project Assignment Sheet is used to indicate to the programmer a list of the modules which are to be changed and where to place the modules upon completion of the task. Next to each of the modules being modified are spaces for dates to indicate changed documentation, production of current listings, and when each of the modules were replaced in the central library. One objective of this form is to insure that all modules are replaced in the central library, maintaining the most current version of a module. When these forms are prepared for each task and filed by system an accurate history of system modification is established. If the activity in and out of the central library is monitored and a task created for every change accompanied by a Project Assignment Form, solid control will have been established over changes being made to a system. Figure (4) is a sample of a Project Assignment Form.

PROJECT TIME ESTIMATE WORK SHEET

TASK NUMBER ____________ DATE: ________________

TASK NAME ____

SUBMITTED BY ____

PROJECT PHASE	Specs Documentation	Code	Test	MAN DAYS
Investigation				
Programs:				
I				
II				
III				
IV				
V				
Test Data Creation				
System Tests				
Production Turnover (Documentation, streams, etc.)				
Clean Up				
***TOTAL MAN DAYS				

COMMENTS: ____

Figure (3)

TASK ASSIGNMENT SHEET

SYSTEM:____________________

TASK: NUMBER__________ NAME:____________________

WORK ACCOUNT____________________

LIBRARY ACCOUNT____________________

				·DATE DOCUMENTATION UPDATED·			
FILE NAME (CBL/MBC/EXE)	TEST DATA	FILE LOCATION PPN	DATE REPLACED ON LIBRARY	WRITTEN	PRODUCTION NOTIFIED	X-REF LISTING	DATE WORK ACCOUNT CLEARED

TASK COMPLETED: PROGRAMMER____________________ DATE:____________________

COMMENTS:

____

____

____

____

Figure (4)

Once a task has been approved it will either be assigned immediately or be held until some future time. As mentioned earlier the job of providing equal service to multiple constituents can be overwhelming. The need for a systematic approach which enables tracking of projects , yet takes a minimum of time to administer, is the main concern of the next part of this Task Management System.

The first point of concern is the tasks in progress. There is a constant need to be able to answer various questions about current projects. What systems are being worked on? What tasks are currently being worked on? What stage is the task in? What is the estimated completion date? How far off schedule are we? The Task In Progress Report provides the information necessary to answer all of the above questions at a glance. Figure (5) is a sample of a Task In Progress Report.

The Tasks In Progress Report is maintained in sequence by system or administrative department in order to easily see the amount of effort being expended on each system. When a task is approved, a unique number is assigned along with a brief title to identify the project. New tasks are added and completed tasks are removed on a weekly basis. When it becomes necessary to extend a completion date the original date remains on the report. The new date is added to the report along with the initials of the individual who made the new estimate. This process continues until the task is completed, giving a history of project slippage.

TASKS IN PROGRESS

ADMINISTRATIVE SERVICES WEEK ENDING 12/8/78

TASK NO.	TASK NAME	STATUS	COMPLETION DATE
ACCOUNTING			
ADMISSIONS			
397	DESIGN NEW ADMISSIONS SYSTEM	INVESTIGATING	3/01/79
FIN. AID			
110	FISCAL OPERATION REPORT	TESTING	12/15/78
291	ADD FUND CODES	CODING	12/22/78
303	DOCUMENTATION CLEAN-UP	WRITING	1/01/79
HOUSING			
LIBRARY			
297	AUTOMATE OVERDUE NOTICES	TESTING	1/15/79

**************** TOTAL TASKS IN PROGRESS = 21

Figure (5)

The second point of concern in task management is that of the tasks waiting assignment. There is always more work requiring attention than manpower resources allow. In dealing with the stockpile of tasks several questions must be addressed. Does one system have a larger backlog of projects than the others? How many tasks are waiting for each system? Within each system, what is the priority of projects? How long will each task take? Are there any mandatory completion dates? The Tasks Waiting Assignment Report provides the information necessary to answer all of the above questions at a glance. Figure (6) is a sample of a Task Waiting Assignment Report.

The Task Waiting Assignment Report is maintained in sequence by system or administrative department in order to easily see the backlog for each system. New tasks are added and tasks which have been assigned are removed on a weekly basis. The man days estimate for each task is derived from the Project Estimate Worksheet. The completion dates are indicated for only those tasks which have a mandatory completion date. The majority of tasks should not fall into this category since no realistic completion date can be decided upon, until the project assumes an active status.

One consistent problem with managing a service organization is trying to keep your customers satisfied. The problem is further complicated when the mystique of the computer shrouds the efforts being expended to reach that goal. A most important use of the Tasks Waiting Assignment Report is to show at a glance

TASKS WAITING ASSIGNMENT

ADMINISTRATIVE SERVICES WEEK ENDING 12/8/78

SEQ. NO.	TASK NO.	TASK NAME	MAN DAYS	COMPLETION DATE
ACCOUNTING				
1	391	CLEAN-UP VENDOR FILE	3	
2	392	NEW OBJECT DESCRIPTIONS	5	
3	405	STANDARDIZE DATE FORMAT	4	
4	190	OBJECT SUMMARY	14	
ADMISSIONS				
1	370	REGISTERED NEW STUDENTS LIST	10	1/15/79
2	368	TRANSFER STUDENTS LIST	10	
3	244	ROLLOVER INTO REGISTRATION	14	9/01/79

*************** TOTAL TASKS WAITING = 74

Figure (6)

that there can only be one task per system having a number one priority. The report can be understood by the user and used to let them select their own priorities. This simple tool can significantly reduce antagonism between the requesting department and the computer group.

At times the worth of a service organization is questioned as well it should be. Since the computer group is a service organization a certain amount of scrutiny must be expected. Two facts which can make the questioning more intense are the high cost associated with computing and the lack of understanding of why computer projects are so complicated. The question becomes, "What have you done for me?" The human memory is somewhat frail often serving only the current needs of the individual. The Tasks Completed Report provides the information necessary to answer the question. Figure (7) is a sample of a Tasks Completed Log.

The Completed Task Log is maintained in sequence by system or administrative department in order to easily see the tasks which were completed this year. Completed tasks are added to this report as they are removed from the Tasks In Progress Report. The completion date is also indicated on this report to provide a chronological history. More detailed information about the task can be obtained by retrieving the specific Task Request. The specific programs that were changed can be identified by reviewing the Project Assignment Sheet.

COMPLETED TASK LOG

Administrative Services Week Ending 12/8/78

Task No.	Task Name	Completed Date
ACCOUNTING		
340	Add Endowment To System	10/13/78
359	Accounting Rollover	11/15/78
ADMISSIONS		
177	SAT List	3/07/78
200	Admissions Operating Manual	2/08/78
FIN. AID		
109	Production Voucher Job	1/06/78
278	Year Check On Transactions	9/22/78
307	Modify Vouchers to New Codes	8/25/78
LIBRARY		
209	Library System Study	4/28/78

******************** TOTAL COMPLETED TASKS = 210

Figure (7)

At the end of the Completed Task Log is a summary of the number of tasks completed each month with a total for the year. Although these numbers must be reviewed in proper perspective, considering lengthy tasks versus short tasks, a definite trend or magnitude of work accomplished is evident.

Having discussed the monitoring reports, the mechanism for determining project status and plans follows. Within the computer group there is a need to be aware of project activity and to maintain a work load balance among the staff on a regular basis. Several questions must be asked of the staff on a periodic basis in order to achieve this goal. Who is working on what project? How many different tasks is each person working on? What is the status of each task? What problems are occuring in the tasks? Were there any production problems that had to be attended to on an emergency basis? What are the plans by each person for each project during the next period? Along with these questions several reminders need to be made to each person concerning what projects they are working on and the corresponding completion dates.

The gathering of the above information could easily consume considerable amounts of time. Since a task exists for each project two reports are used, one for soliciting a statement of project status and another for planned project work. The Status Report and Plans Reports are circulated to each programmer/analyst requiring a statement of status, problems, and plans. This obviously does not replace a face to face discussion, but does insure that all people and projects are reviewed. If there is limited time for project review the problem areas will get the needed attention first rather than waiting their turns.

The Status Report provides the information necessary to determine an individual's work load, contains a reminder of the scheduled completion dates for each task, as well as providing a universal reporting mechanism for task status. Figure (8) is a sample of a Status Report.

A similar format is used in soliciting project plans. Tasks that have been added to the Tasks In Progress Report will appear on the Plans Report under at least one individual as a new assignment. The only significant difference between the Plans Report and the preceding Status Report is the exclusion of production problems (hopefully no one plans such problems). Figure (9) is a sample of a Plans Report.

Even with the Status Report and Plans Report filled out there is a need to clarify various statements which were made on the reports. This provides a meaningful basis for having a regularly scheduled weekly staff meeting which in turn forces the computer group management to review the reports regularly. Many important objectives can be accomplished in conjunction with clarifying project status and plans. The completion dates which have elapsed should be revised in this meeting, creating a consciousness of problems concerning poor planning. This is not a one sided problem since the Project Estimate Worksheet was

STATUS REPORT

ADMINISTRATIVE SERVICES

STATUS OF WORK FOR THE WEEK ENDING 12/15/78

TASK NO.	TASK NAME	STATUS	COMPLETION DATE
BARBARA CARLIN			
397	DESIGN NEW ADMISSIONS SYSTEM		3/01/79
***	PRODUCTION PROBLEMS		
FRANCIS KING			
401	REFORMAT W-2		1/01/79
402	NEW FICA LIMITS		1/01/79
***	PRODUCTION PROBLEMS		
JAY NELSON			
397	DESIGN NEW ADMISSIONS SYSTEM		3/01/79
403	DOCUMENT ON-LINE REGISTRATION		12/22/78
***	PRODUCTION PROBLEMS		

Figure (8)

PLANS REPORT

Administrative Services

Planned Work for the Week Ending 12/22/78

Task No.	Task Name	Plans	Completion Date
	Barbara Carlin		
397	Design New Admissions System		3/01/79
	Francis King		
401	Reformat W-2		1/01/79
402	New FICA Limits		1/01/79
	Jay Nelson		
397	Design New Admissions System		3/01/79
403	Document On-Line Registration		12/22/78

Figure (9)

used, involving the individuals in the project. Assignment of new tasks are made public at the weekly status meeting. A review of production problems can uncover flaws in the documentation standard, procedural problems, etc. The key is to establish credibility of project control by having consistent project evaluation involving the individuals of the computer group.

Task management is not a particularly difficult problem to solve on paper. The development of forms and diagrams showing exactly the stage of a project, and how close it was to the projected schedule would be a reasonable undertaking. The complication ensues when there are more than one or two projects being worked on concurrently. The real question is whether the time exists to maintain on a timely basis all the forms and diagrams. If the answer to this question is no then the task management or project management system must be considered impractical. This is not to say that a very detailed project management system is not the goal. To make something function properly there must be time available to make it work.

The Task Management System which has been explained takes very little time to administer, yet it provides maximum control and an awareness of the time investment. The Task Request controls the suggestions, ideas, and mandatory changes by requiring authorization from the users responsible for a system. The Project Assignment Sheet controls changes to the program modules, documentation, and insures that everything has been properly backed up after a project is complete. The Tasks In

Progress Report indicates which systems are being modified. Each task represented under a system has a general status and estimated completion date indicated. The Tasks Waiting Assignment Report shows which systems have a backlog of tasks. Under each system the individual tasks have been assigned a sequential priority. The priority of waiting tasks can be assigned by the user, serving as an effective means of making the user aware that everything can't be done at once. The Completed Task Log establishes a historical list of modifications made to a system. The Status Report and Plans Report provides a consistent format for inquiring about the status of each project.

The Task Management System just described is a description of the obvious. With the growth of management information systems and more sophisticated project control techniques it is all too often forgotten that everything has its price. There is no question that more detailed project control is the goal. However for every new procedure and/or form it takes a specific amount of time to administer that procedure. In any environment whether it is public or private, the supervisory manpower resource is limited and therefore has limited time to attend to each duty. Although this system does not have all the idealistic detail that most managers would like, it attends to the basic needs of project management without occupying inordinate amounts of time to administer.

REPORT ON A NEW RELATIONAL DATA NEEDS ASSESSMENT METHODOLOGY

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The presentation summarizes the results of a project applying a new methodology to relational data needs assessment in top administration. The methodology was developed and used at the University of Minnesota. Its purpose was to determine which of the many inherent relationships contained in the data collected in the central administrative processes will be used in the future by the University's top administrators. The project analysis results will be used to provide for a more efficiently designed database for the institution. The authors believe the methodology will provide data base administrators with an important tool for designing efficient databases in the future.

Report on a New Relational
Data Needs Assessment Methodology

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Background

Database technology has brought with it a whole new field of study--the study of data. We now understand from the work of Codd, Martin, Date and others that data has an inherent structure which can be traversed, manipulated and modeled.[1,2,3] We also know that databases designed using the inherent data structure as a model will probably require less maintenance over time and be more responsive to current as well as future user needs. However, the data processing industry has not yet developed an efficient relational database management system for large databases (by relational system here it is meant one which records all relationships in the data structure).

The problem then was to develop a method for determining which of the relationships in a given data structure will be most frequently used and therefore reflected in the efficiently designed data base. This paper discusses a methodology for determining the relational needs of the top administration of a large university.

The objectives of this study were to test the effectiveness of a variety of clustering techniques, with associated data collection procedures, for:

1. discovering the latent data element structures in the minds of higher education administrators based on their decision-making and information needs, and

2. communicating these structures to technical experts in the design of management information systems and data bases.

Success in these objectives would permit the optimization of relationships among data elements in the development of a new management information system or the restructuring of an existing system.

Methodology

A multistep process was utilized which includes: (1) Data Element Identification; (2) normalization to identify entities; (3) entity grouping by administrative users; and (4) analysis of the groupings. The methodology was tested at the University of Minnesota using major data files currently in use. (For a more detailed discussion see Baltes' "Data Needs Assessment for Higher Education Administration: A Methodology.")[4]

(1) Data Element Identification--The relative stability of a mature educational institution with well established conventional data systems led to the assumption that the data elements required in the database system will be, for the most part, elements which are already being collected through current data processing systems. Fifteen master files were identified by the systems analysts in the data processing department which contained most of the data elements used in current systems. Although there are some 400 files currently in use, those not included in this study are either a subset of one of the fifteen selected but in a different sequence; or a data file from a system not considered to be an integral part of the University's administrative systems, such as the printing plant inventory file or the telephone billing file.

These fifteen files contained a total of approximately eleven hundred data items. The names and descriptions of the elements were stored through a computerized data dictionary for ease of access and manipulation. The data items were also described on a deck of cards which was used in the normalization process described in the next section.

(2) Normalization--E.F. Codd defined the normalization technique as a method for grouping data items into a set of relations, producing a relational

model. The normalization technique was used with the data items collected in the previous step in order to group the items into a manageable set of entities to be used in the survey described below.

The process of normalizing the 1,100 items included the following steps:

(a) Data items whose function was primarily data processing related and contained no information for the user were eliminated. Examples of this type of data item include record codes, transaction codes, file identification items and update codes. Approximately 300 of these types of data items were eliminated from the original set of 1,100.

(b) Systems analysts who were thoroughly familiar with the meanings and usage of data items were asked to describe the relationships between data items.

(c) The items were viewed as one relation of 800 domains using Codd's definition. Then the normalizing steps were followed, the complex relation was, in effect, broken down into 39 simple relations written in third normal form. Each simple relation was given a name based on the real world entity which its data elements described. For example, the relation containing the data items which describe employees was called the employee entity. Each of the simple relations contains data items which describe attributes of an entity which is either: Physical (for example, student, building), administrative (for example, registration, account), or organizational (for example, parent department). The 39 entities yielded by the normalization process are as follows:

1. Advanced Standing Academic Record
2. Account
3. Accounting Balance
4. Alumni Membership
5. Applicant Test Scores
6. Application
7. Application Control
8. Appointment
9. Authorization
10. Building
11. Business Address
12. Campus Address
13. Class Schedule
14. Course
15. Course Section
16. Courses Registered For
17. Current Month Accounting Transaction
18. Deduction History
19. Deductions
20. Degree Awarded
21. Donor Entity
22. Employee
23. Employee Class
24. Employee Tax Status
25. Expense Class

26. Home Address
27. Insurance and Retirement
28. Non-College Academic Record
29. Parent Department
30. Position Control
31. Promotional History
32. Registration
33. Room
34. Salary History
35. Skill and Education
36. Student/Applicant
37. Student Financial Data
38. Student's Family Data
39. Year-to-date Payment

Further information on the normalization process may be found in the texts already mentioned by Codd, Martin and Date.

(3) Entity Grouping--The subjects for the entity grouping survey were selected through the process described below. Although the full survey instrument is not included here, the instructions which subjects were given are shown below. The survey yielded a number of entity groupings which the subjects believed would be useful to them.

Seventy persons were identified by the Vice Presidents of the University to be interviewed in a long-range planning effort being carried out by the data processing department concurrently with this study. During the interviewing process, several interviewees indicated that they do not currently use data produced by the data processing department, nor did they see any future use for such institution-wide data. An example of this kind of situation is the Director of the University Press who essentially is running a small business which he manages primarily from data generated within his own department. The original 70 interviewees were reduced to 54 subjects for this survey. The group was made up of: all vice presidents, provosts, vice-provosts and deans; selected persons with primarily planning responsibilities and certain administrative staff persons.

The vice presidents originally selected this group of people as being representatives of their respective areas who ought to have input to the data processing department's long-range plan. It was therefore believed that they also would have the greatest needs for data from a future administrative database and therefore ought to have input to its design through this survey.

The survey was conducted by mailing to each subject a packet containing a deck of 39 cards containing descriptions of each entity, survey instructions and response forms to be returned to the researcher. The instructions were as follows:

Step 1 Read all the steps of the process.

Step 2 Take a few minutes to identify the major decision areas in your administration in which data from the University's database, either in summary or detail form, would be helpful.

Step 3 Describe each decision area on a separate decision form. Five forms have been provided for this purpose. You may select as many decision areas as you wish up to five.

Step 4 Indicate the number of times each year that you would need updated reports from the computer for this decision area in the space called "frequency of access."

Step 5 Look at each entity card and describe if the attributes of that entity would be useful data for the first decision area.

Step 6 For each entity which would be helpful for the first decision area, write the entity number on the decision form in the spaces called "Applicable Entity Numbers."

Step 7 Repeat steps 4 through 6 for each decision area.

Step 8 Return the decision forms.

(4) Analysis of Administrator Grouping--A number of analysis techniques were tested including: observation of matrices showing the number of times each entity was grouped with each other entity; factor analysis of the groupings; and several cluster analysis techniques.

The matrices proved to be too large and complex to permit useful analysis by observation. Factor analysis of the groupings showed no useful clusters of entities and was therefore ruled out as an analysis method. Before discussing the results from cluster analysis methods tested, a brief discussion of cluster analysis may be useful.

Blashfield suggests that there are probably 100 different clustering techniques available today, each described in terms unique to the field in which the method originated.[5] Each clustering technique has characteristics which may cause it to be more or less useful for clustering a given set of data. The impact of the characteristics of a given method on a given set of data cannot always be predicted so that results of a given cluster analysis must be tested for their validity. Further, Blashfield recommends that rather than select a particular clustering method the researcher may wish to try several methods and compare the results before selecting one method. In this way, the researcher can analyze the differences between results to decide which method has characteristics which will be most useful for the analysis.

Blashfield describes four clustering methods in his article each of which was used in the analysis of the administrator groupings. The differences between the methods are in the way that each links entities into groups or clusters. All four methods are hierarchical clustering methods which give an output format suited to the analysis required here. The four methods are:

> Single linkage--Each entity is linked into the cluster which it is most like, or in this case, used with most frequency.
>
> Complete linkage--Each entity links to the cluster containing all entities which are more similar to it than are all the entities of any other cluster, where similarity is measured by the frequency with which entities were used together.
>
> Average linkage--Each entity links with the cluster whose average value is most similar to it.
>
> Minimum Variance or Ward Method--This method clusters entities in such a way that the variance between entities within a cluster is minimized.

Anderberg has written a series of programs which will perform hierarchical cluster analysis by seven different methods including those mentioned above.[6] In this study all four methods were used, the results of which will be described in the Results section. The complete linkage and average linkage methods appear to yield the most reasonable solution based on comparison of these solutions to current data file structures.

Results

The data structures as currently used may be approximately divided into seven major groups: employee, facility, address, course, student, financial and development. These structures were compared to the cluster analysis to determine the reliability of the results as well as relationships which appear in the results but are not in current structures. Although a number of different clusterings were computed and each provided additional insight to the probable future relational requirements of top administrators, only one clustering result is presented for discussion here (see Baltes for detailed discussion of the analysis and findings of the study).

Figure I below shows one hierarchical clustering of the entity groupings. The strength of a relationship between two entities or one entity and a cluster may be measured by the point at which they join in the hierarchy where entities with strong relationships (used together with high frequency) will connect on the left hand side while those with weaker relationships will connect further towards the right. For example, administrators grouped employee tax status with year-to-date payment data very often while employee tax status was almost never grouped with registration data. Ultimately, by design, this analysis method will always link every entity in the groupings.

Examination of the cluster results shows that only five separate groupings (divided by the dash line) can be identified compared with the seven in current structures. The top cluster compares roughly to the employee file. The second cluster is approximately comparable to the current financial file. The third cluster compares to the current course file. The fourth cluster combines the current address and development files and the fifth relates to the current study file.

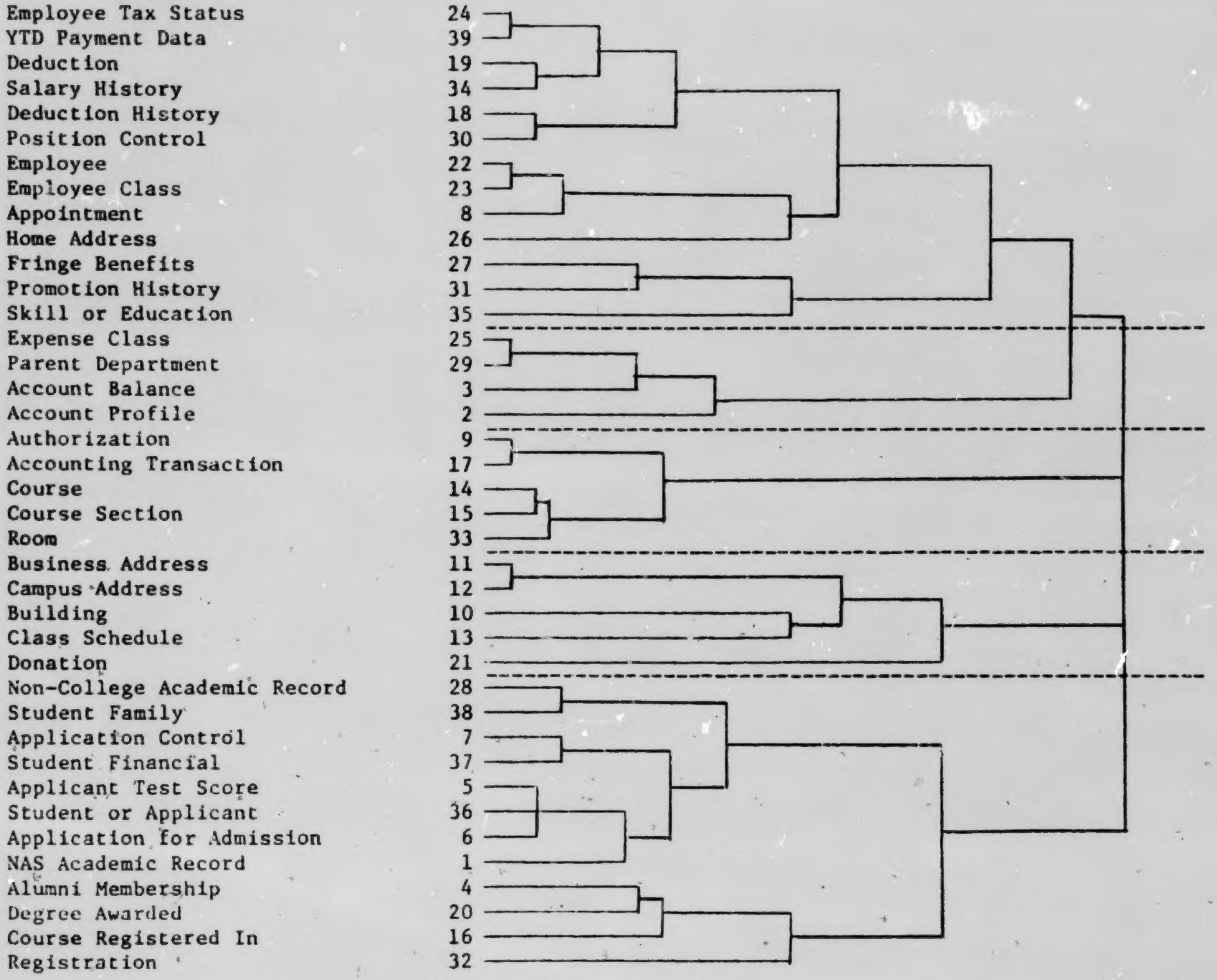
Employee Tax Status 24
YTD Payment Data 39
Deduction 19
Salary History 34
Deduction History 18
Position Control 30
Employee 22
Employee Class 23
Appointment 8
Home Address 26
Fringe Benefits 27
Promotion History 31
Skill or Education 35
Expense Class 25
Parent Department 29
Account Balance 3
Account Profile 2
Authorization 9
Accounting Transaction 17
Course 14
Course Section 15
Room 33
Business Address 11
Campus Address 12
Building 10
Class Schedule 13
Donation 21
Non-College Academic Record 28
Student Family 38
Application Control 7
Student Financial 37
Applicant Test Score 5
Student or Applicant 36
Application for Admission 6
NAS Academic Record 1
Alumni Membership 4
Degree Awarded 20
Course Registered In 16
Registration 32

Figure 1

The summary statements drawn from this analysis are:

(1) Top administrators view alumni data as part of the student file rather than the development file as current structures carry the data.

(2) Top administration is not concerned about facilities data except as it relates to the course schedule and campus address.

(3) Authorizations are an accounting entity related to building construction and maintenance. Although current structures carry authorization data in the accounting system, top administration appears to see authorization as strongly related to room. (Current data processing systems can relate authorization data with rooms only with great difficulty and expense.)

Although the above comments relate to one clustering, a number of them were done. As each of the clusterings are examined, additional relationships not supported by current systems were uncovered--relationships which future databases must support if they are to be responsive to management's needs.

Conclusions

The methodology was proven to be a very useful tool for the database administrator for anticipating future relational requirements of the databases to be designed. Some difficulties were encountered in getting responses and the ability of some subjects to understand the instructions. An interview format might have resolved some of these problems.

The implications of this study for database designers must be viewed from the perspective of a total systems design scenario. The database designer must know a good deal more about the data resource than was necessary to design a conventional single application file. The designer must understand: the logical views which the database must be able to present for all users; security and privacy constraints for all entities in the database; pecularities of the database system which will be used and their impacts on the physical implementation of the data base; the value of the data as a resource of the institution which will have implications on what the institution will demand in terms of efficiency of use and frequency of use; and many other aspects which have not been mentioned. This methodology could be effective not only in building a relational model of the data base reflecting top administration's view of the data but for finding all logical views that users may require of the database. If prospective users were asked to group entities not by decision area but by frequency of use or level of security or privacy constraint and so on, the database administrator could cluster each set of responses to get different perspectives of the data, all of which will need to be taken into consideration in the final implementation of the database.

Footnotes

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[5] Blashfield, R.K. Mixture Model Tests of Cluster Analysis: Accuracy of Four Agglomerative Hierarchical Methods. Psychological Bulletin, 1976, 83(3), pp. 377-388.

[6] Anderberg, M.R. Cluster Analysis for Applications. New York: Academic Press, 1973.

A STATUS REPORT ON THE IMPLEMENTATION OF THE STRUCTURED TECHNOLOGIES IN A UNIVERSITY ENVIRONMENT

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The paper reflects on the results of the implementation of the Structured Analysis, Structured Design, and Structured Programming over a one-year period and contrasts the results of the new environment with the conventional approach to program development. Both the positive and negative side of the results are covered with the reactions of programmers who have gone through the transition to the new methods and a management analysis of the results from a project manager's and Systems and Programming manager's viewpoint.

1. INTRODUCTION

What is the "University Environment"? Is the systems development function of a university significantly different from what one would expect in industry? Can improved design and programming techniques be implemented in a university? We feel they can.

As is true with most educational and governmental institutions, we have a lower salary scale than is customary in industry. We are also a part of a state personnel system which regulates the job titles, job descriptions, and pay scales. As may be expected, we have a high turnover in personnel. A large percentage of our staff members are with the University for educational reasons. Either they, or members of their families, are attending school and will probably only remain in the area until educational goals are met. A large percentage of the people available for employment are recent college graduates or people with very limited experience in the data processing area. This results in a constant educational and training effort which, regardless of our approach to the development process, is going to consume a great deal of our available manpower.

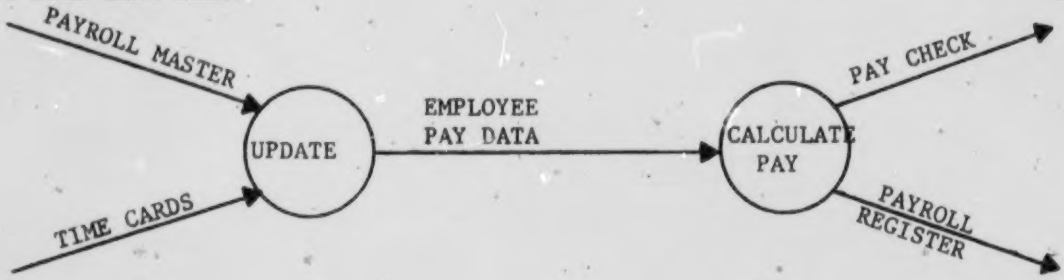
In terms of size, we are a relatively small systems development department consisting of ten people to cover all of the administrative application areas of the University. We divide our staff into application area oriented teams which handle both maintenance of existing systems and development of new systems. We also, as with most DP departments, spend a fairly high percentage of our staff time just maintaining existing systems. For us, this percentage is around 40 percent of our staff. I think one might conclude that we have a similar environment to that of other medium sized universities.

II. STRUCTURED TECHNOLOGIES

What are the "Structured Technologies" which we attempted to implement? These can be broken down into three major areas. They are Structured Analysis, Structured Design and Structured Programming. We also utilized the concept of a Structured Walkthrough as a part of the implementation of all three of these technologies.

In structured analysis we used the concepts and principles defined in the book Structured Systems Analysis by Chris Gane and Trish Sarson. "The underlying concept of structured analysis is the building of a logical model of a system, using graphical techniques which enable users, analysts, and designers to get a clear picture of the system and how its parts fit together."[1] The methodology involves building a system from the top down by successive refinements first producing an overall data flow then developing detailed data flows. The other tools used by structured analysis are a data dictionary, a logical data structure diagram, and tools to express logical rules.

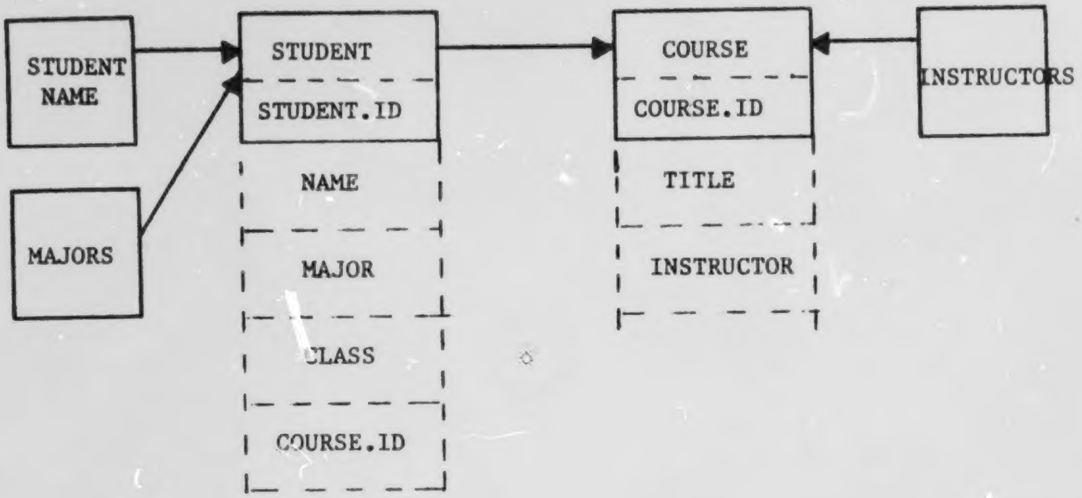
A data flow is a graphic representation of the flow of data through a system rather than flow of control. An overall data flow for payroll processing might look like this:



The objective of the process is to define the functions which must be performed in order to transform the data from its inputs to the desired outputs. The data flow diagram is a means of restating a problem or process in a manner which emphasizes the logical flow of data and deemphasizes the procedural aspects of the problem.

The data dictionary is a means of collecting information about data flows, transactions, data elements, data element values, and processes throughout the analysis process. The objective is to systematically catalog the vast amount of data which is accumulated during analysis. Also, we facilitate communications and make the process more precise when all of the terms are defined the same way. The data dictionary should contain a current listing of all names, aliases, abbreviations, and characteristics of all data flows, transactions, data elements, data element values, and processes in a system.

The data structure diagram enables us to express the internal logical organization of our files. It is a graphic tool to describe logical data structure requirements. We can easily see what the contents of a file are by examining the data elements in the data flow into and out of the file. What we are more concerned with is the logical structure. This structure depends on how fast the user is going to want to access the various data elements. For example, the requirement to furnish course information from a student master file in five seconds versus 20 minutes would affect the structure of the data base. So the data structure diagram shows the various immediate accesses the user wants. "The analyst makes two rather different uses of the Data Structure Diagram. First, he uses it to write down a description of the current environment in such a way that they can understand and verify it. A second use is to help a user reconstruct his true data store requirement, divorced from the arbitrary composition of his current store."[2] For example, a Student and Course Master file might have a Data Structure Diagram like this:



The last tool of structured analysis is a collection of many separate tools used to express logic. The following tools are used to explain the functions which take place inside the process bubbles of the data flow diagram. The tools are structured english, decision tables, and decision tree structures. These are all graphic tools to express the logic required to perform a function. For example the structured english to analyze adding a course might look like this:

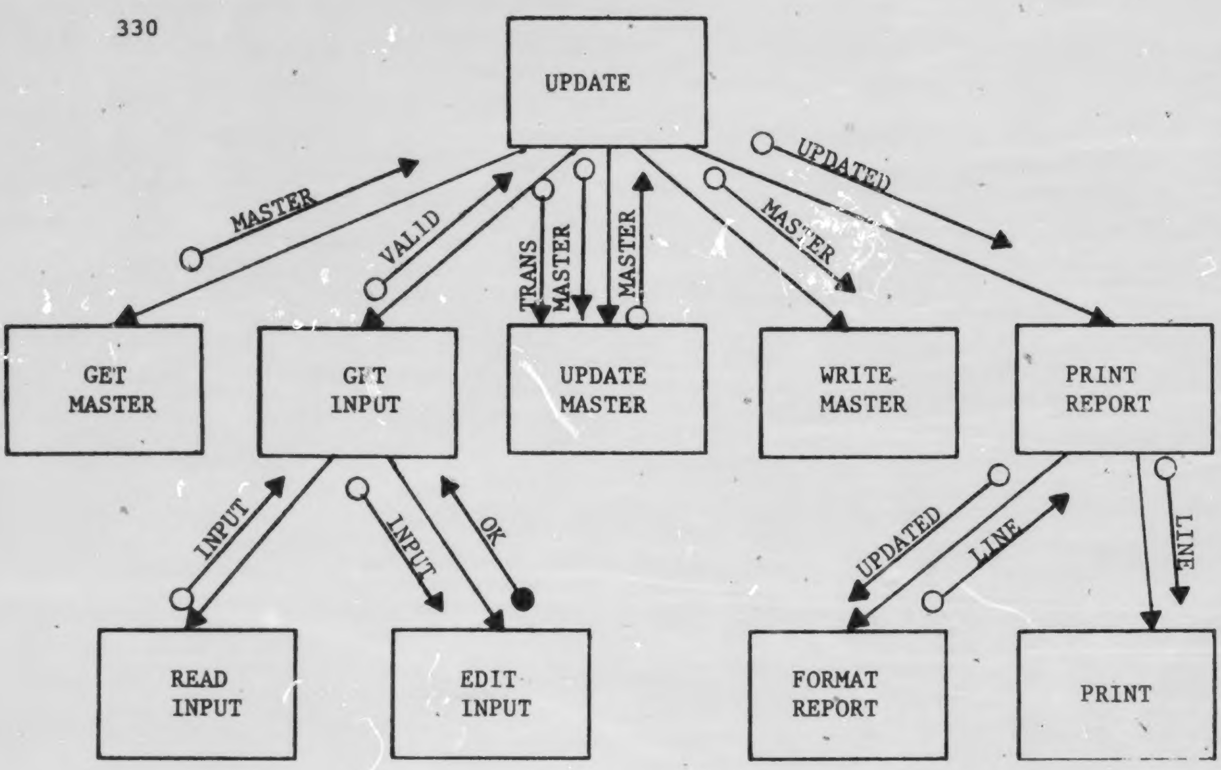
```
IF NUMBER ENROLLED IS LESS THAN MAX CLASS SIZE
    ADD ONE TO NUMBER ENROLLED
    ADD COURSE TO STUDENTS RECORD
ELSE (NUMBER ENROLLED EQUAL MAX CLASS SIZE)
    DISPLAY "CLASS FULL" MESSAGE
```

When all of these tools of structured analysis are used together, they produce a set of functional specifications for a system. This logical model of the proposed system is easier to communicate to users and easier to maintain and modify than conventional analysis techniques.

The concepts of structured design we use are based on the ideas of Ed Yourdon and Larry Constantine in their book Structured Design and Reliable Software Through Composite Design by Glen Myers. The basic premise of structured design is to design the component modules of a system and their interrelationships to accomplish specific functions defined in the logical model created by structured analysis. Each peice, or module, in the system represents one small, well defined function to be performed. A module's function, whenever called, is the transformation of some input to some output. In other words, a module's function is "what happens when the module is called."[3] A module should be viewed as a black box in that we do not care how the module performs the function.

The defined function of each module and the interrelationships between modules are the prime concerns in the structured design process. A properly defined module contains closely related, or cohesive, intramodular elements. High module cohesion results in modules which are independent from other modules, less susceptible to errors, reusable, and easily extendable. Since one of the objectives of structured design is to have modules that function as independently as possible, the relationship between modules should be minimized. In order to minimize the dependency of one module upon another, the connection, or coupling, between the modules must be minimized. This can be accomplished by supplying a module with only the data necessary for the module to perform its function.

Loosely coupled, highly cohesive modules are the end result of a good structured design. These modules function almost independently of one another and can be depended upon to perform the same function time after time. Since each module performs a specific function, a module can be reused whenever the module's function recurs in another design. The result of the structured design process is a structure chart of the modules required to perform the desired function. A Master File Update structure chart might look like this:



"In summary, then, we can state the following philosophy: implementation, maintenance and modification will generally be minimized when each peice of the system corresponds to exactly one small, well defined piece of the problem and each relationship between systems pieces corresponds to a relationship between pieces of the problem."[4]

For structured programming, we use the text titled Learning to Program In Structured COBOL by Yourdon, Gane and Sarson. Structured programming is an attempt to design program modules in a more precise way in order to increase readability and maintainability. It is often described in terms of eliminating the GO TO statement. The basic concepts of structured programming is that all proper programs can be broken down into three basic constructs. The three constructs are as follows: (1) process construct; this is any sequence of statements with only one entry and one exit; (2) a generalized loop construct; this is a Perform Until or Do While type statement; and (3) If construct; this is a logical decision resulting in the performance of one or two mutually exclusive processes. The three structured programming constructs can be applied recursively to handle more difficult logic. The result is a program which can be read from the top to the bottom and is simpler to understand and easier to maintain.

Structured programming eliminates the use of the traditional flowchart as a means of documentation or analysis of a program. Flowcharts emphasized the procedural aspects of a program. The problem is with the correspondence between the flowchart and the program code. A strict interpretation of the flowchart leads to coding with GO TO statements which structured programming tries to avoid. The alternatives to flowcharts are structured flowcharts or pseudocode. The structured flowchart, or Nassi-Shneiderman diagram,[5] limits the programmer to the three structured programming constructs thus the diagram will correspond to the program. "Pseudocode, also called program design language, gives the programmer a good balance between the precision of programming languages and the informality of English."[6]

The end result of the analysis, design and coding process is to push the actual coding as far back in the cycle as possible. This results in early detection of design and logic errors before the solution is converted to code.

In addition to the three structured technologies, we implemented a Structured Walkthrough as described by Yourdon in his book Structured Walkthroughs. The walkthrough is a peer group review of any product. It promotes what has been refered to as "egoless programming,"[7] where programmers no longer consider it an invasion of privacy to have other programmers review their programs. The walkthrough can be used at various times in the development process to review programs, structured flowcharts, pseudocode, structure charts, etc. "Walkthroughs are one of the most effective ways known to improve the quality of a computer program,"[8] where the most important aspect of quality is correctness. "Programming groups using walkthroughs report that they have been able to reduce the number of errors in production programs by as much as a factor of ten."[9] The walkthrough finds errors faster because the author has a number of mental blocks which prevent him from seeing errors in his product as quickly as a group of peers. In addition, the walkthrough helps spot inefficiencies, enforces compliance with standards, increases the readability of programs and communicates new ideas.

A walkthrough has the following characteristics: (1) at least two other people besides the producer of a product meet to review the product to see that it works according to specification and that it conforms to standards; (2) the detailed results of the review are not communicated to management for possible use in personnel evaluation; (3) all materials to be reviewed are distributed with sufficient lead time to the walkthrough to allow all participants to become familiar with the material; (4) during the walkthrough all comments are directed at the product and not at the producer; (5) the review should raise issues but not resolve them; participants are not allowed to suggest corrections or changes; and (6) each participant must sign the review report and if the product was accepted (which requires unanimous vote of the participants) each participant becomes responsible for its correctness.

III. IMPLEMENTATION

Approximately a year and a half ago we were planning a conversion to a data base management system which over the next five years would have replaced all of our existing administrative programs. We considered ourselves at a starting point where we could re-evaluate our existing standards, documentation methods, and project control procedures. We also had some outside funding which would allow us to increase our staff size. In order to obtain this funding, we had to develop systems which could support multiple institutions. Also, some of the systems would be developed by other cooperating instituitons. This necessitated that we have a very precise set of programming standards which would insure that development efforts carried out on one campus could be maintained on another campus. The results which had been reported in earlier structured development projects indicated increases in programmer productivity and reduced maintenance after the system was installed. As a result of these factors, we made the decision to implement these technologies for our new development efforts.

The implementation of the structured technology was accomplished in several steps. At the beginning of the project, the majority of our existing staff was not familiar with the concepts of the structured technologies. The three project managers and the director of systems and programming attended classes on structured analysis, structure design and structure programming taught by the Yourdon consulting firm. Using the information gained from these classes, an in-house education program was then developed. Utilizing available texts, as well as sample programs, the class could be presented to existing personnel and any new employees as needed. The program included classroom type lecture, as well as non-classroom reading assignments to be done during work hours.

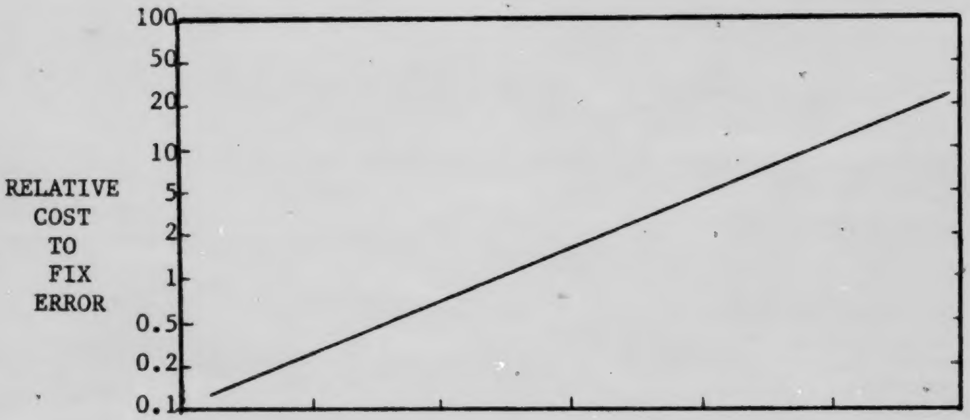
While the educational process was continuing, a set of simple but comprehensive standards was developed. These standards were to be used by all members of the development projects both as guidelines and as a measurement device to determine if a product conformed to the structured concepts. Without concise standards on the proper programming constructs to be used, formatting rules, and coding style guide lines, the structured approach probably would not produce more readable programs. The rules should be unambiguous and of sufficient merit so that a programmer will not be unduly stifled by their adoption. "Two themes underlie this entire effort:

1. The readability of programs is much more important than their writability.

2. The long-range maintenance of programs is so costly that a significant effort to reduce cost must be made as early as possible."[10]

The great value in adherence to uniform rules is so that programmers may more easily read and understand programs written by others. Also, there is a need to develop coding techniques that reduce the complexity of programs. Simply following the principles of structured programming does not ensure the creation of 'good' programs. It is just as possible to write hard-to-read, impossible-to-maintain structured programs as it is conventionally-coded programs. Modules must be properly designed before they can be properly written.

One of the main assets of the structured technology lies in the ability to detect errors as early as possible in the development cycle. "Evidence has been produced showing how the cost of correcting an error grows out of all proportion, the later in the system development life cycle it is detected."[11]



PHASE IN WHICH ERROR DETECTED [12]

A critical factor in early error detection is the use of the structured walkthrough at key points in the development process. The walkthrough is probably the most important process of the whole procedure of implementation of the structured approach. It provides the police mechanisms to see that standards are met. By exposing other members of the development team to the walkthrough products one gains in familiarity and education on the project. Less experienced people see the code of more experienced programmers and a gain in the level of technical expertise can be obtained.

IV. RESULTS

The results which we have obtained from implementing the structured technologies are as follows:

1. Properly designed and written structured code is easier to maintain and modify than conventional code. Each module performs one and only one function. When a problem or change occurs the module dealing with that indicated function is readily identifiable. The pseudocode serves as a guide to the logic of the program's designed function.
2. Since each module performs one and only one function, once a module is written and tested it may be used again. Anytime the same function appears in another design the existing module may, and should, be utilized. This results in a significant savings in time as the functional module does not have to be recreated. We have experienced that as many as 25 percent of the modules in a program may have already been completed as part of a prior program.
3. The materials created in the normal development process (structure charts, pseudocodes, structured flowcharts, etc.) form adequate documentation for the system. The investment in additional documentation is minimized.
4. By breaking programs into modules which usually differ in level of complexity, more efficient utilization of the staffs' ability can be accomplished. Inexperienced personnel can be assigned to the simpler modules making them productive more quickly and avoiding the assignment of problems beyond their capability. Experienced personnel can be

assigned to more complex problems and are freed from the more routine tasks.

5. The major objection to the structured technology is that it stifles initiative. However, the people making these objections are usually the ones whose code is tricky and hard to maintain.

V. CONCLUSION

In conclusion, we feel structured technologies offer advantages in an environment where turnover and limited experience are a factor. These technologies limit the scope of the problem new people have to grasp before they can become productive. All of the significant major systems decisions are made in the design process and each programmer only has to deal with a small functional unit of the problem. One can expect structured technologies to improve productivity and management control of the development process.

As a caution to those who might attempt to implement only portions of the structured technologies, it is quite true that they are somewhat independent philosophies. One could have structured design without structured programming and one could have structured programming without structured design. Likewise, one could have structured analysis, structured design and code in a conventional way. Because they are all very complementary type technologies where many of the concepts learned in one carry over to another, it seems quite natural to implement them as a package. Probably the most critical steps in the process are (1) the development of adequate standards which cover the scope of the technologies; (2) provide a comprehensive inhouse education program on the structured technologies; (3) use the walkthrough as a police mechanism to insure that the standards are implemented; and, (4) the scope of the project which one chooses should be one of manageable size so that the complete systems life cycle can be gone through in not more than three to four months.

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TRACK III
USE OF INFORMATION SYSTEMS

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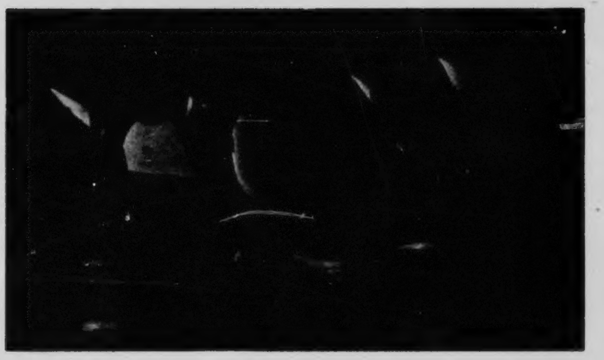

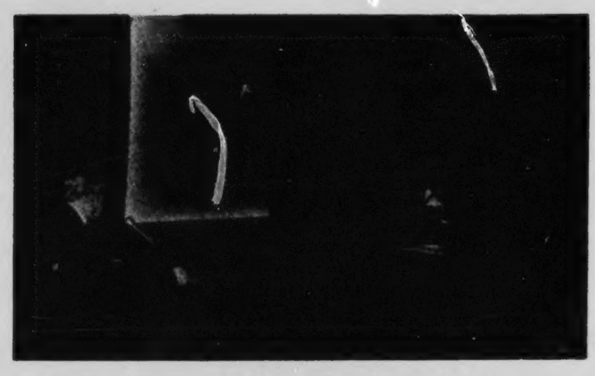

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LOAD-LEVELING OF STUDENT WORK AND FINANCIAL AID ASSISTANCE IN UNIVERSITIES

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ABSTRACT

Most universities receive federal monies for assistance in hiring student workers for various academic departments and administrative units. One of the problems which arises in the assignment of the students who receive student work and financial aid is that the "luck of the draw" by a department of students who are eligible for receiving federal work study money can make the dollars budgeted for student workers "stretch" beyond normal means or, conversely, the lack of receiving students who are eligible for federal work money can make the amount of work performed by student workers "shrink."

An innovative new plan has been initiated at Southern Illinois University, Carbondale, whereby monies and therefore hours of work by students can be allocated on an equitable basis among all of the academic departments and administrative units. There seems to be no impact on students receiving federal work study monies. The control systems and utilization ramifications describing this phenomena are explained.

LOAD-LEVELING OF STUDENT WORK AND FINANCIAL AID ASSISTANCE IN UNIVERSITIES

by

Barry L. Bateman

THE SETTING

Chartered in 1869 as Southern Illinois Normal University, Southern Illinois University has grown from a small rural campus to a university that enrolls over 22,000 students annually while encompassing some 7,500 acres.

The University is divided into six colleges and eight schools including professional schools of medicine (located in Springfield) and law. In addition, associate degree programs are offered by the School of Technical Careers.

The Graduate School offers master's degree programs in 62 fields and Ph.D. programs in 20 while enrolling over 3,000 students annually.

Located in Carbondale (population 26,900) some 350 miles south of Chicago and 90 miles southeast of St. Louis, the campus is in the heart of the lake and forest area of Southern Illinois.

The main campus at Carbondale consists of some 300 buildings and the entire physical plant is valued at nearly $250 million. A sister campus in Edwardsville enrolls over 10,000 students annually making the Southern Illinois University system one of the largest in the country.

With a faculty that numbers over 3,300 and a library that consists of over 1.5 million volumes, Southern Illinois University offers to the student an excellent all-around academic selection and one of the finest environments to be found on any campus in America.

University powers were granted in 1943 with the name changed to Southern Illinois University in 1947. The University's first Board of Trustees was appointed in 1949. The first doctoral degree was awarded in 1959, and final legislative restrictions on degree programs were removed in 1963. In June, 1969, the University received approval to develop schools of law and medicine. During its 109-year history the University has had twelve presidents.

THE ENVIRONMENT

Southern Illinois University at Carbondale has continually evolved in its use of electronic data processing to support its academic service and administrative support functions. As the technology of computing resources have developed, the opportunity to utilize these resources for improved processing of data has created a constant pressure to develop new applications. It becomes increasingly necessary to establish goals and priorities for development in order to utilize resources for the maximum benefit to the university.

In order to more fully understand the environment in which we are dealing, it is necessary to give an overview of the status of information systems for the University. Approximately eighteen months ago the University decided to build an on-line data base for Financial Accounting System. In order to do so we studied various data base management systems and chose the Information Management System (IMS) of IBM. After becoming familiar with the data base management techniques and IMS procedures, the University successfully installed its first on-line system, Financial Accounting System. At that time it became necessary to have an Administrative Systems Review

Committee to prioritize and investigate the associated costs for converting older batch processing systems to the new technology with the overall goal of reaching an integrated data base system or systems for the University in the near future. Figure 1 shows the Southern Illinois University application systems and their component parts. Note that Financial Aids is part of the Student Information Systems. Figure 1, however, can be misleading in that it shows the basic systems and the component parts of the system. What is unclear is which parts of the systems are currently satisfactory. In order to ascertain this, one must look at the automated data availability in these systems and the deficient components of these systems. Figure 2 shows this information. The information in Figure 2 gives one an idea of what data elements are available and a feel for what the potential centralized data base systems might contain. The committee then met to plan what data bases would be necessary for completing the information necessary for the successful implementation of centralized data base system which would serve the needs of the total university. Figure 3 shows the data for planned data bases. In addition to this, the planning revealed that there were several other areas requiring study, i.e., within the Student Information System, Alumni; within Facility Information System, Space and Property Control; in Research, the Clearinghouse function; Service, the Clearinghouse function; and Development, a Donor's file.

Since the committee which was doing the study was a University-wide committee with broad constituency based representation, there were, of course, multiple special interest groups represented. For this reason the committee had to decide upon a suggested evaluation criteria. The following four items were found to be the most important four evaluation criteria:

1. Return on Investment

    - Implementation cost (Estimated)
    - Dollar return/savings
    - Cost/Benefit ratio

2. Impact

    - Number of organizations and people affected
    - Qualitative effect
    - Effect on accomplishing overall objectives

3. Success

    - Degree of acceptance
    - Probability of implementation
    - Length of implementation
    - Risk
    - Resources available

4. Demand

    - Value of existing systems
    - Relationship with other systems
    - Political overtones
    - Needs

The results of this Committee's deliberations prioritize all systems into three priority groups. The number one priority was an on-line Accounts Receivable System. Priority two we had the Personnel System and the Student Information System. Priority three was all other remaining systems. One must realize, however, that despite these priorities work continues in all three priority categories. Therefore, even though the major effort of the University would go into an Accounts Receivable System, many of the smaller subsystems within the main systems have been and continue to be developed. One of these is the Student Work and Financial Aid package.

THE FINANCIAL AID ENVIRONMENT

In a recent article from the Illinois Community College Bulletin, Paul M. Starnes and Toni C. Harris have analyzed student financial aid in Illinois Public Community Colleges for the Fiscal Year 1978.[1] Although this data was focused primarily on the Community Colleges, several facts were relevant to the financial aid environment in the public universities.

For the past seven years, the Illinois Board of Higher Education staff has conducted an annual student financial aid survey to determine the numbers of students receiving aid from various sources. These surveys also sought to identify the total value of awards to students and the sources from whence they came. The data were collected and categorized according to the type of higher education institution attended by the students receiving aid.

The most recent student financial aid survey (April, 1978) had a very high rate of survey instrument return: 162 returned out of 164. This may be an indicator of the high interest that exists among all institutions, private and public, about this subject. A corollary reason for the high interest may also lie in one of the uses of the data: development of budgetary recommendations and responses to legislative questions about student financial aid.

The 1978 survey reveals that the total aid to students enrolled in institutions of higher education in Illinois increased 10.8 percent when compared with the 1977 amount: $434.14 million in 1978 versus $392.99 million in 1977. Community colleges, however, actually experienced a decline of 1.0 percent in student aid during this period. Community college students received $526,500 less in aid in 1978 than was received in 1977.

When we compare the aid received in 1978 by students enrolled in private colleges and public universities to the aid received by students in community colleges, the results are:

Type Institution	Percentage Change in 1978	Amount Changed
Private Colleges	+14.3%	$ 26.6 million increase
Public Universities	+10.4%	$ 16.2 million increase
Community Colleges	- 1.0%	$526.5 thousand decrease

The study states that the reason for the decline is the change in number of students receiving the Illinois Military Scholarship, the National Direct Student Loan, and College Work Study awards.

The Illinois State Scholarship Commission (ISSC) Monetary Award Program continues to be the largest State-supported grant program. The number of individual ISSC awards increased at the community colleges in 1978, but decreased at private colleges and public universities. Community college students, however, continued to receive the lowest total dollar value and lowest average award when compared with the private colleges and the public universities. This is due to the fact that ISSC awards are based on the rate of tuition at an institution.

The average grant assistance per full-time-equivalent student when all programs are considered was $450 for public universities, $235 for community colleges, and $1,200 for private colleges in Fiscal Year 1978. The Fiscal Year 1978 survey shows that the Basic Educational Opportunity Grant (BEOG) and ISSC programs clearly are the two most important needs-based financial aid programs for undergraduates attending public institutions. The relative importance of the BEOG and ISSC programs varies among institutions due to differences in the income distribution of students and the level of the student's total budget.

The BEOG program was designed to provide grants up to a maximum of $1,400, primarily for low-income students with parental income of $12,000 and below. ISSC awards, on the other hand, provide grants up to a maximum of $1,550 for tuition and fees, but the income levels of students served are much higher than for the BEOG programs.

Due to the relatively low mean income at which students can qualify for BEOG awards, it is not surprising that ISSC provides students attending private institutions with 2.3 times the amount of grant aid received through the BEOG program. At the community colleges in contrast, the BEOG program provides students with 2.9 times the amount of aid received through ISSC. Figure 4 shows the distribution of financial aid by source by public universities.

An interesting contrast to the philosophy and methods used in the United States is that provided in England.[2] In England the Department of Education and Science has been very interested by the arguments about grants versus tax allowances in the United States. They have an interesting manner of resolving this problem. Any student who gets a place in higher education in Britain is entitled by that very fact to a financial award. Nowadays, he or she automatically gets the tuition fee paid, regardless of wealth, providing that he is a student resident in the United Kingdom. The prospective student then has an entitlement, if this is his first course in higher education, to a maintenance award for food, lodgings and so forth--but that right is qualified by being based upon a means test of his parents. They have the same problem as we do in classifying the student who has broken with his parents and who sees himself as independent, and like us they haven't resolved this. If he qualifies for support, the student gets a rate of maintenance which is about $2000 a year for the years of his degree course, and that roughly will cover his maintenance--not at a very high level, but it is enough to live on. At least 90 percent of their higher education students get some sort of award, and of these, about 40 percent get full mandatory awards. What they are doing now is removing the child tax allowances; they are in the middle year of removing allowances to parents for boys and girls in full-time education. They are using this revenue to offset the means test, in other words to reduce the contribution that parents have to make to their sons' and daughters' maintenance. The tax allowance is being recycled into the award system to make the award system more generous.

A final set of facts and figures needs to be examined in order to set the stage for the examination of the methods of distributing student work and financial aid at Southern Illinois University at Carbondale and the rationale behind these decisions. Figure 5 shows the expenditure from state general revenue funds for Illinois Higher Education Fiscal Year 1968 to 1979. As you can see, inflation has consumed most growth in state support for higher education after Fiscal Year 1971. The current dollar state support has grown from 292 million to 847 million from Fiscal Year 1968 to Fiscal Year 1979, a change of 190 percent. However, the constant dollar state support grew from Fiscal Year 1968 to Fiscal Year 1979, but from Fiscal Year 1971 to Fiscal Year 1979 the general revenue fund expenditures for higher education ranged only from 390 million to 425 million in Fiscal Year 1968 dollars.[3]

These facts and figures are indicative of what has been happening to higher education in general over the past decade. However, we also need to study what is happening to the public universities. Figure 6 shows the expenditures from state general revenue funds for Illinois Public Universities. As shown here, Fiscal Year 1968 expenditures of $235 million have increased to a Fiscal Year 1979 appropriation of $532 million, a change of 126 percent. A close look at the graph, however, shows that the Fiscal Year 1979 appropriation represents the first year of constant dollar growth since Fiscal Year 1971. This once again shows that the state of funding for higher education is at best a tenuous proposition.

The prior appropriation figures lead us to the point which we wish to make, i.e., Figure 7, which shows the expenditure from state general revenue funds for Illinois State Scholarship Commission Programs. This shows that the expenditures of general revenue funds for the ISSC Programs have increased from $11 million in Fiscal Year 1968 to a Fiscal Year 1979 appropriation of $83 million. The figure also shows that in constant dollars the general revenue funds support for ISSC increased rapidly from Fiscal Year 1968 to Fiscal Year 1973. Since Fiscal Year 1963, however, constant dollar general revenue funds support has been the rule. It is important to note, however, that federal funds have been available to supplement the general revenue funds to support ISSC since Fiscal Year 1975. A total of $4.7 million in federal funds is appropriated for Fiscal Year 1979.

THE BACKGROUND AND SOLUTIONS

In February, 1978, the University was interested in the budget management problems concerning keeping track of student payroll between federal work study and regular work students. This was an annual problem in terms of knowing where budgetary commitments are in individual departments as a result of the combination of federal work study students. It was the desire, therefore, that some procedures be worked out to assist management of the budgetary problem.

In order to solve this problem, the Director of the Office of Student Work and Financial Assistance at Southern Illinois University-Carbondale spent a considerable amount of time talking to financial aid directors throughout the Midwest. As a result of these discussions, he submitted the following proposal as a reference point to begin discussions about possible changes in the Student Payroll System on the Southern Illinois University-Carbondale campus.[4]

I. A Quasi Encumbrance System

A. Employers state how many hours and the rate they are willing to pay for a student work job. This is forwarded with the work request to the Student Work Office.
B. The student is made a work award for a specific amount of money and terms of work. This is done for all student work jobs that a student holds.
C. The University can use reports at some administrative level to monitor the amount of student wages that are committed.
D. The Budget Office can make work allocations based on prior experience of student wage use within each office. This can be based on total number of students, dollars, and/or mix of federal work study students.

II. Changes in the Payroll System

A. An encumbrance at each account occurrence in the student payroll system.
B. A bi-weekly report to the fiscal officer which can list both the encumbered and year-to-date amounts of money expended from each account.
C. A quarterly report broken at the Dean or Director level up through the Vice Presidents for management reporting.
D. The payroll system will probably have to interface with FAS to get the breakdown levels in Item C. There is a need for a work monitor function from the financial aid overcommitment part; therefore, the student payroll system will need to store the student ID number where different from the Social Security number.

III. Education

Seminars and/or presentations, in cooperation with Learning Resources Center for Audio Visuals, to brief fiscal officers and deans on the new changes in the payroll system. One of the comments made by several of my financial aid counterparts is that there is some fiscal officer responsibility that cannot be avoided in looking at the budgetary problems between federal work study and regular work students.

IV. Payroll Monitor

A. A report and notice to students within $200 of their authorized amount of work.
B.. A report and notice to all students within $50 of their authorized amount.
C. An automatic termination letter for all students when they exceed their award amount.

V. Potential for Research and/or Administrative Uses

  A. Tabulation of award by financial need.
  B. Tabulation of award by adjusted gross income.
  C. Tabulation of award by class standing.
  D. Tabulation of award by job type.

After studying this proposal, the Associate Director of the Computer Center responded with two alternative approaches based upon the on-line Financial Accounting System which is designed to handle encumbrances.[5] His thesis was that if the data was provided regarding initial commitments and adjustments, then the remaining support for this system already exists for management control. The two alternatives which he proposed were:

I. Encumbrance

  A. Employers state how many hours and the rate of pay for a student at hire time. This is forwarded on/with the work request to the Student Work Office.
  B. The Student Work Office determines the funding commitment for the remaining fiscal year and forwards this data to General Accounting.
  C. General Accounting posts the commitment to the ledgers in FAS similar to a purchase order or other commitment. This could be by blanket commitment or per each student. This would be determined later.
  D. Expenditures from the student payroll would liquidate the commitment each pay period. FAS currently supports this if the transaction generation would include the OC number. A blanket number would be easiest to implement.
  E. Reports from FAS currently support fiscal officer, dean/director, and vice presidential responsibility level reporting. This includes budget, adjustments, expenditures, encumbrances, and budget balance available information. Student work commitment data would automatically draw down from the wages pool and show the budget commitment for student wages.
  F. An open commitment list would be provided to the Student Work Office for monitoring the commitments.

II. Encumbrance Adjustments

  A. Employers reporting student work terminations would cause the Student Work Office to calculate the remaining commitment. This would be forwarded to General Accounting as an encumbrance adjustment.

  B. General Accounting would post the adjustment to the FAS ledgers.

The alternative to the above method would be:

III. Optional Consideration

A. Federal work funds could possibly be utilized in subsidiary ledger 2 as another source of funds similar to capitation. A separate subcode could be used to identify federal work study funds. This way a fiscal officer's account would show total student work expenditures. Prior to utilizing this option several discussions must occur on topics ranging from budgeting to annual reports.

Some advantages accruing from this alternative are:

1. Faster implementation by utilizing existing capabilities.
2. Less paperwork because a "personal services" type system would not be required.
3. Less education of the administrators since they are already familiar with the reports.
4. Maintain wage budgeting at pool level while tracking student work commitments.
5. Minimum change to the student payroll system.
6. Potential decentralized data entry of commitments by Student Work Office.

The basic approach which was adopted was this last option. In summary then the old way of processing entitled a student who qualified for federal work study to have his earnings calculated and then approximately 20 percent was charged to the departmental account and 80 percent was charged to the financial work study restricted account. A sharp fiscal officer who hired only financial work study students could balloon his student wage funding because only 20 percent of the expenditure was charged to his account. A monthly report showed the distribution of financial work study expenditures by account. This was utilized by the Student Work and Financial Aid Office and the fiscal officer.

Based only the monthly financial work study report, the Student Work and Financial Aid Office knew what areas expended financial work study funds and how much. The usage figures were relatively stable for the past four years when summarized by ledger. These ledgers are:

2 - Current Unrestricted Budgeted Expenditures
4 - Activity Accounts
5 - Auxiliary Enterprises
6 - Restricted

These dollars were allocated by the normal allocation process in each administrative area the same as other budgeting activities for each ledger.

Under the new concept, financial work study funds are budgeted directly in ledger 2 accounts. The total wage expenditure is posted to the departmental accounts. Thus, a fiscal officer's report shows his total budget and expenditures without regard to source of funds. Behind the scene, the 80 percent calculation is still made and an offsetting or reversal expenditure is made to a financial work study ledger 2 account and reposted to the ledger 6 financial work study account. In this way, restricted funds appear to be intermingled with unrestricted funds but are correctly posted per accepted accounting standards.

Ledgers 4, 5, and 6 are handled a little differently as legal restrictions prohibit the apparent intermingling of funds. In this case, the process is the same except the offsetting or reversal is posted to each individual account. Thus, the fiscal officer report shows the total wages expenditure and the offsetting financial work study entry. His budget and expenditure totals reflect only funds "earned" by that account.

The secret behind this capability is something we added to FAS at Southern Illinois University. A field in each transaction identifies the source of funds (cash) utilized. A fiscal officer does not know what "cash" account supplied the money. He only knows that he has "x" dollars to spend. These dollars could be general revenue, income funds, financial work study, or a multitude of local resource dollars. Fiscal Affairs determines the source of funds to be used to meet the payroll or pay a bill.

In summary, the new procedure was implemented very easily due to the abilities of our on-line Financial Accounting System and has received a very good response from the fiscal officer's throughout the University. The fact that the whole system is transparent to the fiscal officer and that no additional training on the management of student work funds was necessary has been an added bonus. The only negative aspect which we have found concerning this matter is that of converting funds. At one time if one wished to convert funds from student wages to another area, it was a straight dollar for dollar transfer. At this time, however, one must pay a substantial penalty whenever reallocating student work dollars inasmuch as a proportion of these dollars which show up in the fiscal officer's budget are work study dollars which cannot be reallocated. This may mean that either a fiscal officer must pay a penalty for converting the dollars or a method needs to be devised whereby automatic budget reallocation can take place at least twice a year.

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[3] An Executive Summary: A Profile Of Enrollments, Degrees, Faculty, And Finances For Public And Private Higher Education Institutions In Illinois, State of Illinois Board of Higher Education, June, 1978, pp. 21-30.

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Figure 1 SIU APPLICATION SYSTEMS

Student Information Systems

- Articulation
- Admissions
- Registration
- Records
- Evaluation/Advisement
- Financial Aids
- Alumni
- Student Life
- Student Services
- Counseling (Independent)
- Health (Independent)
- Student Center (Bookstore)
- Housing

Personnel Information Systems

- Applications
- Appointment
- Payroll
- Deduction/Benefits
- Records
- Seniority/Tenure
- Effort Distributions
- Government Reporting

Fiscal Information Systems

- Budgeting
- Ledgers
- Encumbrances
- Accounts Receivable
- Accounts Payable
- Cash Management
- Purchasing/Stores

Facilities Information Systems

- Space Inventory
- Space Utilization
- Physical Plant
    - Job Cost
    - Maintenance Scheduling
    - Utilities
- Property Control
- Service Enterprises

Figure 1 Continued

Library

- Ordering
- Cataloging
- Circulation
- Serials/Periodicals
- Theses/Dissertations
- Learning Resources

Independent

- Foundation Accounting
- Development
- University Press
- Medical School
- Clinical Services
- Computer Utilization

Institutional Programs

Instructional - Courses/Classes
- Degree/Concentration/Specialization
- Test Scoring/Instructor Evaluation

Research - Clearing House - Departmental
- Research General
- Grants/Contracts

Service - Clearing House - Local
- State/Regional
- National
- International

Data

- Dictionary/Directory

Figure 2 AUTOMATED DATA AVAILABILITY

	Current	Deficient
I. Student Information Systems		
A. Admissions	Application ACT Auto Decision Contact Letters Statistics	
B. Registration	Cur, Adv I, Adv II Fees Paid Statistics Fee Audit	
C. Records	Biographic GPA - Grad, Undergrad Current Grades Status	Cumulative Student Course History
D. Evaluation	ACT	Scrambled Transcript
E. Financial Aids	ACT Status Veteran Scholarships	Packaging Grants ISSC Payroll as Aid
F. Housing	Applications/Contracts Space Assignment Acct Rec	
G. Bookstore	Inventory Control Sales	Accts Payable Purchase Orders
H. Student Services	Handicap Foreign	CP & P

Figure 2 Continued

	Current	Deficient
I. Alumni	Paid/Non-paid Statistics Mailing Constituent Societies	Fund Raising
II. Instructional Programs		
A. Approved Courses	Attributes Usage (current and past)	
B. Timetable	Past Current Adv I, II, III	
C. Degree Requirements		Degree Requirements Degree History Statistics
III. Personnel Information Systems		
A. Appointments	Biog Appt Notice Leaves	
B. Records	Biog Class/Rank Degrees Short History	Expand History
C. Payroll	Retroactive Pay Deducts Distribution Calculation BW BP MO Pay History	

Figure 2 Continued

	Current	Deficient
D. Benefits	Vacation Sick Leave	
E. Budgeting	Position Control Cumulative Encumbrance Lapsing (auto) budget Salary Increase Snapshot Encumbrance	
F. Skills Inventory		Skills Inventory
G. Applicants		CS Faculty
H. Institutional Research	Unit Cost	
IV. Fiscal Information Systems		
A. Accounting	Ledgers (GL, SL) Encumbrance Mgmt Rptg Fin Rptg	
B. Budgeting	Budget to Actual RAMP	Build Up
C. Acct Rec	Billing	Centralize A/R Cash Control Working Cash
D. Purchasing/Stores	Mgmt Statistics Expediting Vendor	Stores Inventory & Billing Purchasing Commodity Index

Figure 2 Continued

	Current	Deficient
E. Property Control	Land Buildings Equipment	
F. Disbursements	Cumulative Disbursements	
V. Auxiliary Systems		
A. Physical Plant	Job Cost Billing Energy Control	Utility Billing Maintenance Schedule
B. Space	Inventory Utilization Research Overhead	
C. Auxiliary Services		
1. Travel	Vehicle Inventory Utilization Billing	
2. Telephone	Billing	
3. Printing		Job Cost Billing
4. Other		Billing
D. Library	Circulation Theses/Dissertations Cataloging	Ordering Serials Learning Resources Card Catalog
E. University Press	Inventory Shipping Billing Sales	

Figure 2 Continued

	Current	Deficient
F. Clinical Center	Management Statistics Billing	
VI. Other		
A. Computing Services	Usage	
B. Mark IV	User Availability	
C. CMS	User Availability	
D. IMS	Fiscal	Student Personnel Instructional Programs Auxiliary
E. Medical School		
F. High School	Payroll	Accounting
G. Foundation/Development	Ledgers (GL, SL) Mgmt Rptg Fin Rptg	Fund Raising
H. Shawnee Health	Hypertensive Screening	

Figure 3 PLANNED DATA BASES

I. General University

A. University Directory

Mailing and/or home address for all faculty/staff, students, Library patrons, and outside billing agencies, individuals, and organizations.

B. Codefile

Code structures and attributes used within the University.

C. Dictionary/Directory

Catalog of data fields, data bases, programs, transactions, etc., and their inter-relationships.

II. Financial Information Systems

A. General Ledger

Accounts containing assets, liabilities and fund balances.

B. Subsidiary Ledger

Operating accounts containing budget to actual income and expenditure balances. Also requisition and purchase order data for Purchasing/Stores system.

C. Transactions

Both daily input and monthly transaction history for FAS.

D. Vendors

Data and addresses on organizations and individuals providing goods and services to the University.

E. Centralized Accounts Receivable

Summary and detail transactions for students, faculty/staff and outside billing agencies, individuals and organizations. Summary and detail transactions for long term student loans (Eg. NDSL).

F. Commodity Index

Item/class data on goods purchased by the University. Data include General Stores inventory facts (Eg. usage, vendors, backorders)

Figure 3 Continued

III. Personnel Information Systems

A. Employee

Current and past (1 year) employee data containing biographic, position class, directory, appointment, deductions, degree, committee, promotional history and calendar year earnings.

B. Job Classifications

Position classification data along with current employee indicator and civil service applicant data.

C. Position Control

Budget position data with appointments, fiscal year transfer dollars, and current pay data.

IV. Student Information Systems

A. Student

Future, current and past (3 years) student data covering biographic, admissions, director, test scores, financial aid, academic program, SIU degrees, and Medical School data.

B. Student Progression

Course, exam, status data on medical students

V. Instructional Programs

A. Instructional Programs

Courses, classes and concentration/specialization data

B. Medical Course Sequence

Courses, exams, faculty and status data for each level of Medical School.

VI. Physical Facilities Information Systems

A. Service Enterprises/Physical Plant

Inventory of services and billing transaction data

Figure 3 Continued

VII. Library Data Management Systems

A. Library Catalog

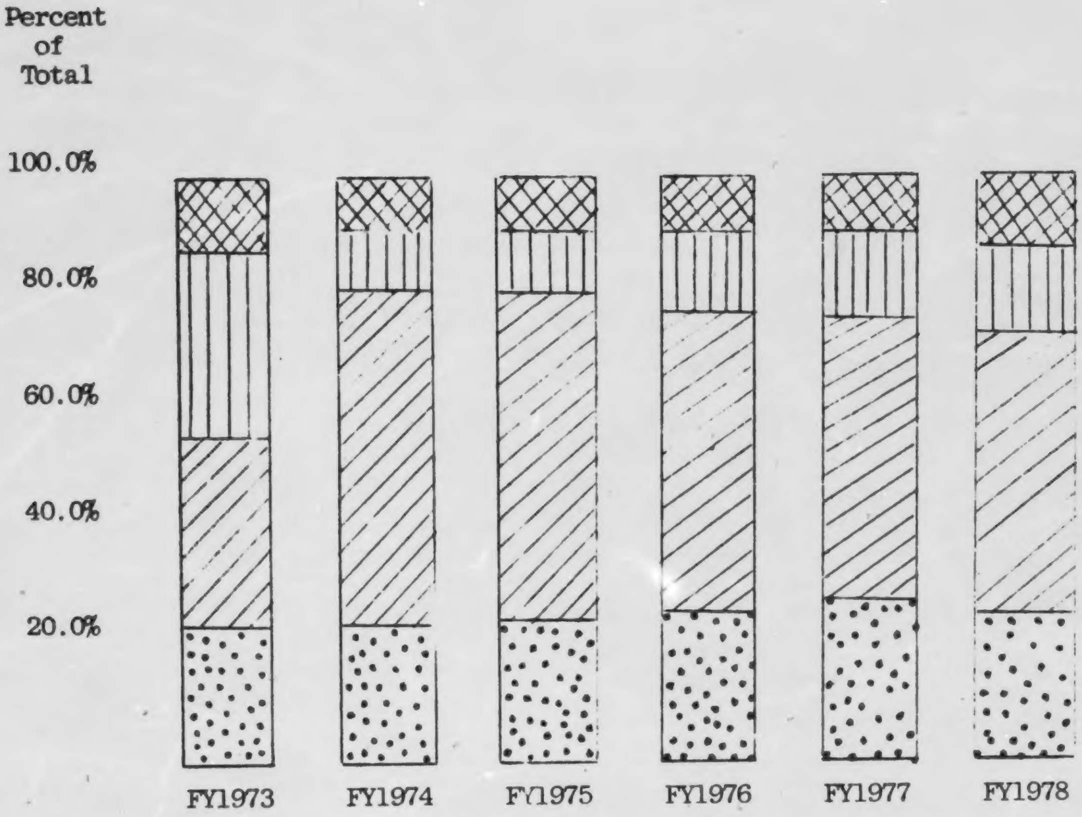
Inventory of cataloged holdings and circulation control data

VIII. Foundation

A. General/Subsidiary Ledger

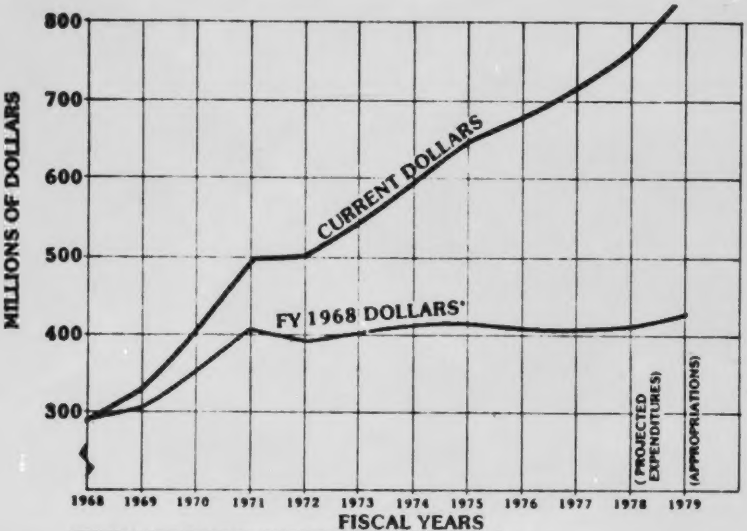
Account balances on assets, liabilities, fund balances, income and expenditures.

Figure 4 FY1973-FY1978 DISTRIBUTION OF FINANCIAL AID BY SOURCE: PUBLIC UNIVERSITIES



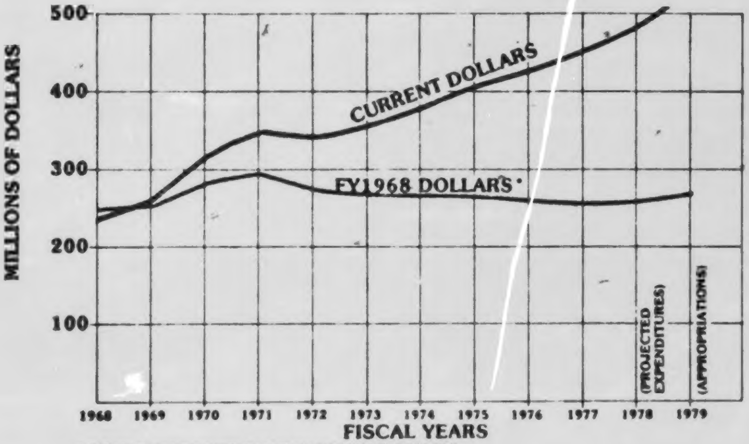
Source: BHE Financial Aid Surveys

Figure 5 EXPENDITURES FROM STATE GENERAL REVENUE FUNDS FOR ILLINOIS HIGHER EDUCATION-FY 1968 TO 1979



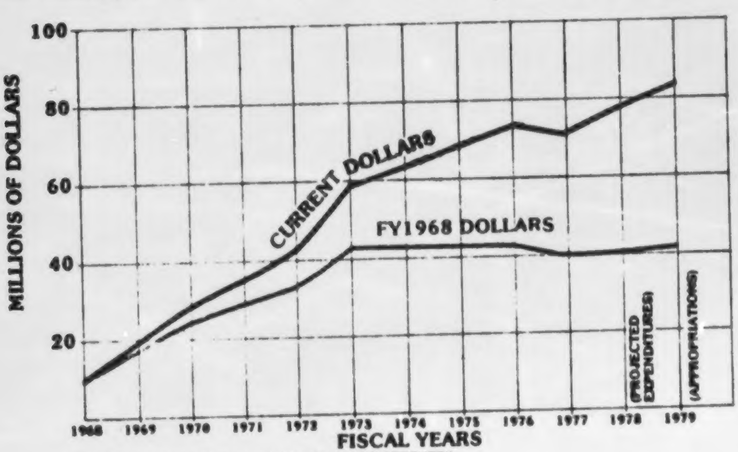
SOURCE ILLINOIS BOARD OF HIGHER EDUCATION RECORDS
*Expenditures deflated by the Higher Education Price Index

Figure 6 EXPENDITURES FROM STATE GENERAL REVENUE FUNDS FOR ILLINOIS PUBLIC UNIVERSITIES



SOURCE ILLINOIS BOARD OF HIGHER EDUCATION RECORDS
*Expenditures deflated by the Higher Education Price Index

Figure 7 EXPENDITURES FROM STATE GENERAL REVENUE FUNDS FOR ILLINOIS STATE SCHOLARSHIP COMMISSION PROGRAMS



SOURCE ILLINOIS BOARD OF HIGHER EDUCATION RECORDS

*Expenditures deflated by the Higher Education Price Index

MIS IN A NON-MIS (UNIVERSITY) ENVIRONMENT

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The major roles of the manager (described in "The Manager's Job: Folklore and Fact," by Henry Mintzberg, Harvard Business Review: Stress, Success...and Survival, 1976) of figurehead, leader, liaison, monitor, disseminator, spokesman, entrepreneur, disturbance handler, resource handler, and negotiator do not appear to be well supported by traditional MIS concepts and practices.

The typical tools we have brought to bear on management support functions are exemplified by data bases, retrieval software, report generators, modeling, etcetera. Given the attention and resources MIS has received over the past decade, why is gossip and other "soft" information cherished more by managers than the "hard" MIS information we provide? Is this a problem or a symptom? Can/should those of us who impact MIS concepts and design react to the situation?

This paper focuses on the implications of the issue outlined above and follows with some alternative proposals and reactions currently or near-future available.

Introduction

If one looks at available literature over the last ten years or the last ten months, few topics have generated more print than that of Management Information Systems (MIS). MIS has been defined (eighteen somewhat different definitions were listed in one book), divined, and defiled. It has been written about by experts and novices, by educators and businessmen, and by bureaucrats and technocrats. Still it is safe to say that a consensus agreement as to what it is supposed to be, what it is, or its worthwhileness has not been reached.

This paper attempts to examine the MIS concept from the perspective of certain commonly held assumptions about management and, thus, about what MIS is designed to do versus what the manager actually does. This concept, the authors believe, leads to an expectations gap, particularly in a University setting. Although hard and fast answers are not proposed, some suggestions are set forth as to how this expectations gap might be narrowed if not closed.

What is Management?

> The term (management) encompasses not only the process itself by which the basic functions of running an enterprise are performed but also the people who administer this process.
>
> When management is used within the first context, the functions encompassed are generally the classical ones as expounded by Henri Fayol: planning, organizing, staffing, directing and controlling. When used within the second context, the term includes not only those who make use of the DP (Data Processing) resource, but also those who oversee the process which ensures that the users make effective use of the resource.[1]

This statement is current (published in June 1978) and typical of management vocabulary. The words may be changed slightly as Drucker does in setting forth his "Five Basic Operations of Management": (1) setting goals and objectives (planning), (2) organizing (organizing), (3) developing people (staffing), (4) motivating and communicating (directing), and (5) measurement (controlling).[2] However, the "bottom line" continues to be basically the same as that introduced by the French Industrialist in 1916.

The Typical MIS

In developing the framework for a MIS, it is not uncommon to first define the functions of management, secondly define information, and finally to define a system. Once this is done, the three definitions are integrated and intermingled into a definition of MIS. Given that management has been defined, a typical scenario follows:

> Next, what does "information" mean? The terms information and data are often used interchangeably. But, there is significant difference between these two terms.
>
> Data is (sic) the basic representation of an event. It is our raw input. It is what we start with. Data is the raw material from which information is developed. Data is transformed into information through an infusion of purposeful intelligence, so that it (information) communicates knowledge to help the user arrive at decisions for proper execution of the functions in the management process.
>
> In other words, information is data that has been culled, analyzed, interpreted and presented on a selective basis in a format that aids the understanding of the situation and that fosters the making of better decisions (than without it). But, because management must perform many different functions, information at one level of usage may only be data at another level...
>
> What does the term "system" mean?...
>
> (One) way to define the term is by considering it in a chain of events. There are inputs into a process; there is a processor that does one or more operations over the inputs; there are outputs from the processor to serve as new inputs to other processors or to be used directly for feedback; there are controls for monitoring the ongoing performance of the processor by comparing the outputs to some predefined standards; and there is the feedback loop which reacts to deviations between the output and control standards so as to maintain the established limits of the imposed controls...

> ...we can finally pull it all together to define MIS as: A system designed to provide to management, useful information in the necessary timeframe to make decisions and to take effective action in planning, staffing, directing and controlling the resources used in the general conduct of an enterprise.[3]

The process just described and its resultant relationship to the management of an institution is well represented by the diagram in the appendix (see Figure 1).

MIS Expectations

> All that top management wants from a management information system is exactly enough of the most relevent information at precisely the right moment to produce an infallible management decision--and, of course, at the least possible cost.[4]

Although this quote may be somewhat an overstatement, the article from which it was taken goes on to list five criteria which any MIS must meet: (1) uniformity of definitions, formats, policies, etc., (2) timely information, (3) total integration with the organization's established accounting system, (4) flexibility, and (5) conciseness of information.[5]

Implied expectations resultant from this "must meet" list are obvious; it is possible to get all of what top management wants.

Needless to say, documented evidence that anyone has ever been successful in meeting or even in coming near to meeting such expectations over any extended period of time are difficult to find. Conversely, evidence of great disappointments are plentiful and calls for the abandonment of the MIS concept are not unheard.

The University MIS

> ...usually (being) in the position of explaining why we needed money or how we had spent money. One of the refrains I heard over and over was, "Why can't you people in higher education manage your affairs more efficiently? Why don't you use modern management techniques like we do?"[6]

This is a quotation from a recent article by an individual who left the academic setting where he had been a dean and a provost to become a "real" executive in the business world. (More will be said later about his observations.) It is illustrative of the general attitude without and to a great degree within the higher education arena.

Discussions of the differences between administration and management by Gardner and Parker[7] and academic administrators versus non-academic administrators by Powers[8] point out very well that there are legitimate differences (1) between the way to "run" a business and the way to "run" an institution of higher learning, and (2) between the administration of academic (departmental chairpersons and deans) positions and non-academic positions (business office, registrar, admissions, etc.) within a college or university.

This paper supports the thesis that a MIS in any setting, university or otherwise, must be designed to support the true management/administration needs of the particular institution. It must also ask if this has been the real objective or perhaps more appropriately, if it has been the objective, has it in fact slipped into a design to meet theoretical functions of management so predominant in the literature?

More must be said about the attitudinal assumption that "business" management is somehow "better" than educational administration. The observations, previously mentioned, by a former dean who is now a business executive follow:

> ...I would suggest that academic management is second to none in making the best use of existing resources. The average academic middle manager--dean, business officer, physical-plant manager--can get more per dollar spent than the corporate manager by half whether the resource in question be services, facilities, equipment, or supplies...

> In summary, academic managers have a far better track record in maximizing resources than do corporate managers.
>
> Second, I would suggest that corporate managers are far superior to academic managers in maximizing revenues. We are talking here about marketing, advertising, distribution, and financing. Nowhere is the difference between the academic and business subcultures more striking than at this point. Business is active, academe passive. Business is goal-oriented, academe survival-oriented. Business managers plan, monitor, pressure, and orient their entire system of management toward sales and revenues. Academe leaves the generation of revenue to a few "outsiders" in the development, business, and admissions offices...
>
> A final word. In their daily lives, academic and corporate managers would find many similarities if they could compare roles. Most organizations today are dominated by "group-think," and the political skills necessary to succeed in either environment are applicable to the other. The jargon and the buzzwords differ somewhat and so do the conventions. But there are more similarities than differences.[9]

If there is merit in the comments just quoted, there may be worth in exploring the supposition that whatever is wrong with MIS in the university setting may also be wrong in the business setting and that the common element may be an inappropriate perspective of what managers/administrators really do.

The Managers Job: A Different View

> The field of management, so devoted to progress and change, has for more than half a century not seriously addressed the basic question: What do managers do? Without a proper answer, how can we teach management? How can we design planning or information systems for managers? How can we improve the practice of management at all?[10]

Mintzberg attempts to shed some light on the questions he raises by listing what he considers to be folklore and fact regarding what managers (he uses the term in the broadest sense) actually do.

> 1. Folklore: The manager is a reflective systematic planner. The evidence on this issue is overwhelming, but not a shred of it supports this statement...
>
>   Fact: Study after study has shown that managers work at

an unrelenting pace, that their activities are characterized by brevity, variety and discontinuity, and that they are strongly oriented to action and dislike reflective activities.

2. Folklore: The effective manager has no regular duties to perform. Managers are constantly being told to spend more time planning and delegating, and less time seeing customers and engaging in negotiations. These are not, after all, the true tasks of the manager. To use the popular analogy, the good manager, like the good conductor, carefully orchestrates everything in advance then sits back to enjoy the fruits of his labor, responding occasionally to an unforeseeable exception.

   Fact: In addition to handling exceptions, managerial work involves performing a number of regular duties, including ritual and ceremony, negotiations, and processing of soft information that links the organization with its environment.

3. Folklore: The senior manager needs adjustment information, which a formal management information system best provides. Not too long ago, the words total information system were everywhere in the management literature. In keeping with the classical view of the manager as that individual perched on the apex of a regulated, hierarchical system, the literature's manager was to receive all his important information from a giant, comprehensive MIS...

   Fact: Managers strongly favor the verbal media--namely, telephone calls and meetings. The evidence comes from every single study of managerial work...

4. Folklore: Management is, or at least is quickly becoming, a science and a profession. By almost any definitions of science and profession, this statement is false...

   Fact: The managers' programs--to schedule time, process information, make decisions, and so on--remain locked deep inside their brains. Thus, to describe these programs, we rely on words like judgment and intuition, seldom stopping to realize that they are merely labels for our ignorance.[11]

Figure 2 (in the appendix) outlines ten roles of the manager, which according to Mintzberg, are much more realistic than the classical functions listed by Fayol and discussed earlier.

Three of the manager's roles arise directly from his formal authority and involve basic interpersonal relationships.

1. First is the figurehead role. By virtue of his position as head of an organizational unit, every manager must perform some duties of a ceremonial nature.

   Duties that involve interpersonal roles may sometimes be routine involving little serious communication and no important decision making. Nevertheless, they are important to the smooth functioning of an organization and cannot be ignored by the manager.

2. Because he is in charge of an organizational unit, the manager is responsible for the work of the people of that unit. His actions in this regard constitutes (sic) the leader role. Some of these actions involve leadership directly--for example, in most organizations the manager is normally responsible for hiring and training his own staff.

   In addition, there is the indirect exercise of the leader role. Every manager must motivate and encourage his employees, somehow reconciling their individual needs with the goals of the organization.

3. The literature of management has always recognized the leader role, particularly those aspects of it related to motivation. In comparison, until recently it has hardly mentioned the liaison role, in which the manager makes contacts outside his vertical chain of command. This is remarkable in light of the finding of virtually every study of managerial work that managers spend as much time with peers and other people outside their units as they do with their own subordinates--and, surprisingly, very little time with their own superiors...

   The processing of information is a key part of the manager's job.

   The manager does not leave meetings or hang up the telephone in order to get back to work. In large part, communication is his work. Three roles describe these informational aspects of managerial work.

1. As monitor, the manager perpetually scans his environment for information, interrogates his liaison contacts and his subordinates, and receives unsolicited information, much of it as a result of the network of personal contacts he has developed.

2. He must share and distribute much of this information. Information he gleans from outside personal contacts may be needed within his organization. In his disseminator role, the manager passes some of his privileged information directly to his subordinates, who would otherwise have no access to it. When his subordinates lack easy contact with one another, the manager will sometimes pass information from one to another.

3. In his spokesman role, the manager sends some of his information to people outside his unit--a president makes a speech to lobby for an organization cause, or a foreman suggests a product modification to a supplier. In addition, as part of his role as spokesman, every manager must inform and satisfy the influential people who control his organizational unit...

   Information is not, of course, an end in itself; it is the basic input to decision making. One thing is clear in the study of managerial work: the manager plays the major role in his unit's decision-making system. As its formal authority, only he can commit the unit to important new courses of action; and as its nerve center, only he has full and current information to make the set of decisions that determines the unit's strategy. Four roles describe the manager as decision-maker.

1. As entrepreneur, the manager seeks to improve his unit, to adapt it to changing conditions in the environment. In his monitor role, the president is constantly on the lookout for new ideas. When a good one appears, he initiates a development project that he may supervise himself or delegate to an employee (perhaps with the stipulation that he must approve the final proposal)...

2. While the entrepreneur role describes the manager as the voluntary initiator of change, the disturbance handler role depicts the manager involuntarily responding to pressures. Here change is beyond the manager's control. He must act because the pressures of the situation are too severe to be ignored: a strike looms, a major customer has gone bankrupt, or a supplier reneges on his contract...

3. The third decisional role is that of resource allocator. To the manager falls the responsibility of deciding who will get what in his organizational unit. Perhaps the most important resource the manager allocates is his own time.

4. The final decisional role is that of negotiator. Studies of managerial work at all levels indicate that managers spend considerable time in negotiations: ...They are an integral part of his job, for only he has the authority

> to commit organizational resources in "real time," and only he has the nerve center information that important negotiations require.[12]

These managerial roles, the authors believe, describe the process of administration, academic and non-academic, as well as the process of management. It follows then that those involved in the design of a MIS might get a better fit in meeting needs if these managerial roles, within the context of a particular institution, are used rather than the classical functions of managers as cornerstones of the system.

What Are the Data/Information Needs of University Managers?

Perhaps the best way to address the question "What are the data/information needs...etc?" is with a short analogy; managers value performance measures as management tools. In the absence of performance standards, however, measurements are little more than intellectual calisthenics. In a similar manner, constructing a management data/information needs listing in the absence of qualified management objectives, is a futile effort. The premises upon which much of the following rest, include the assumption that formal objectives will exist as management decisions are made. That this is almost invariably an erroneous assumption should be emphatically noted! Malcolm Munro, at Calgary University reflects ..."determining the information each manager needs is a particularly difficult task, in fact it is generally recognized to be one of the most difficult phases in the development of Management Information Systems (MIS)."[13] Based on the expressed high level of dissatisfaction so many schools experience with their MIS, one must be highly suspicious of the methodology employed in needs analyses at the beginning of systems development efforts. Before examining alternative approaches to these analyses, it might be well to reiterate to newcomers to the profession the difference between data and information. Data are facts that may or may not be meaningful and/or related; information consists of (usually) facts that convey meaning and/or context. The origin of the following illustration of the data/information distinguishing features may be lost in E.D.P. archives, but was first heard by the authors as Charles R. Thomas, Executive Director of CAUSE, spoke to a seminar of Community College executives--"if you tell me how not to do something, that's data; if I had been going to do it that way, that's information."

Data and Information Needs Analysis

It is the opinion of the authors that failure to adequately address the question of needs analyses is a key factor that puts universities in the category of environments into which MIS is the abbreviation for misfit. Unlike(?) a business, an institution of higher education is just as likely to ask "What do we want?" as it is to ask analytically "What do we need?." Those of us in data processing management roles can aid our institutions in recognizing this problem but the problem here is, after all, one of attitude. We are about as likely to be 100 percent successful in this venture as we would be in convincing the executive to change political parties! The veracity of this observation becomes more apparent as we get to topics such as (1) hard and soft data and (2) the sources of information used in much of the management decision-making process.

For the present, let us look at two methods commonly employed in the determination of a manager's information needs (from the article by Munro, already cited, see Figure 1 in the appendix).

The most obvious difference between the models, other than their approach to the problem, is the fact model B takes into account company/university policy, procedure, and organizational structure. It may be appropriate to assume the decision analysis method would bring us closer to an information oriented, and the data analysis method to a data oriented system, or MIS versus MDS (management data systems), the latter being inherently a contradiction in terms.[14]

Who?

Beyond the methodology employed in the analysis, who (all) should determine needs? The fact that there's no such thing as an "ideal" or an "average" user makes the information analyst's job even more difficult than it would be otherwise. Too many times we see a system developed by "averaging" several managers' input; in doing this, we insure a system that pleases nobody! An editorial in Infosystems (November 1978) recently lamented the futility of involving users in systems defining and development, saying, "Management training in MIS is at the leading edge of any training program, but it can turn too easily to the bleeding edge for the MIS director who strongly suggests many (user) hours of involvement."[15] An infrequently discussed problem for many executives is the middle managers propensity to want to maintain an element of mystery regarding how he or she solves problems; the manager who will only discuss the results of decision-making activities can make the job of the systems development officer a nightmare. As a compounding factor in this dilemma, George Mueller, of SDC points out a major communications problem most of us have experienced--"Most programmers don't understand complex business (we can substitute university) functions any better than top executives understand programming."[16] Most of us acknowledge the fact programmers speak a unique language and have a unique perspective but fail to acknowledge the same of university administration and administrators. Given, then, the difficulties in establishing data needs and the limiting characteristics of human resources, it should be clear we must start our quest for the "perfect" system by having a new (to universities) "hybrid"-type administrator look at information needs by performing analyses of decisions flow(s) and from these exercises work backwards towards needs. The authors defined this individual in a recent CAUSE publication as the Data Base Administrator.[17] When effective coordination exists, "no (information) system can replace effective line managers";[18] a good DBA will assume the responsibility for this coordination.

Data/Information Types and Sources

To a major extent, the needs analyses methods employed determine the sources and the sequence of investigating those sources of data and/or information. Given the luxury of adequate time for so doing; it seems some combination of analyses would minimize the potential for source oversights. Regardless of approach used, the end result of the exercise will be several dozens-to-a-few-hundreds hard data elements and a few needs and sources impressions; impressions that will, in part, at some near future date help in determining such things as sort hierarchies and page break criteria. The remainder of the "impression information" could be labeled soft information. The article by Mintzberg, referenced earlier, elaborates on the role of soft information in decision-making cycles and reports "...the strategic data bank of (an) organization is not in the memory of its computers (hard data/information) but in the minds of its managers (soft data/information)."[19]

To complete the scavenger hunt for data and information sources then, one needs to address the traditional sources including input/output forms and reports and existing data element dictionaries and files, as well as the sources implied by the decision analysis method model. Additionally, one needs to be attuned to "sounds" of soft information paths. The ability to do this typically comes with quality experience in a specific institution or company as the sources and their relative importance will undoubtedly vary place-to-place and time-to-time within a given place. In any case, neither data/information needs nor sources analyses can be successfully concluded in the absence of generally agreed upon information and organization objectives.

One Institution's Approach to a "Mintzberg MIS"

It is unfortunate the Mintzberg article or the work done by Gardner and Parker was not available when early MIS planning and design work occurred at Pepperdine University; not that the ultimate destination would have been all that different but, the authors agree, the route would certainly have been more direct. In the context of this paper, our work is sorted into two parts.

A. Hard Data Sources/Information Channels.

In planning for what later became known as "hard" data/information, the University used four related sources:

(1) An Institutional Research (IR) Module,

(2) Mark IV and Mark IV Auditor,

(3) A Retrieval Module, and

(4) Routine Production Reports (DP and IR output).

Numbers three, four, and Mark IV Auditor are necessary for efficient performances of day-to-day, routine activities. These resources are primarily data assembly tools for middle management and supervisory level staff members. Upper management may occasionally use something from these sources but, if so, it is necessarily as a "snapshot" view of the situation. Our use of the IR and Mark IV software approaches the "ideal" management information resource, i.e., these tools are used in information gathering, long-range planning, historical comparisons/perspective, and for hard data based decision-making activities. In tandum, these data/information sources appear to be satisfying the university's needs of the late 1970's; in the absence of a formal and comprehensive institutional information policy, and given 1980 needs may be significantly altered from those of today, the flexibility afforded by the referenced sources appears to meet current and anticipated needs very well.

B. Soft Data Sources/Information Channels.

While we must acknowledge most soft data and/or information is transferred through almost exclusively informal channels, some planned structures and activities are possible. At Pepperdine University we use:

(1) Committee Structure,

(2) Systems Coordinators,

(3) The Data Base Administrator (DBA) Function, and

(4) "Informal" Modes (DBA meetings, VP interfaces, deans/systems users meetings, etc.).

In our previously mentioned publication (see footnote 17), we discussed the role of our Records Advisory Committees (student and business), since combined to form an Administrative Records Advisory Committee, our User Task Forces, Systems Seminars, etcetera; we also described the role of User Liaison positions. Some elaboration on the evolution of these latter functions might indicate where we are going in the information systems scheme of things. The User Liaison positions have been redefined and are now called Systems Coordinator positions, two for business systems, two for student systems-related activities. Initially the primary function was the collection and evaluation of the "soft" information/decision elements of our systems community, with maybe 33-40 percent time and talent spent on the technical aspects of needs and development. Today, the situation is almost exactly reversed, with something like 66-75 percent of activities being in the analytical and/or technical mode. The point is, once the assessment of soft needs and resources has been identified, maintenance requires fewer (though consistent application of) resources.

Through the Vice President for University Systems, any dean or "major" systems user can convene a monthly meeting of the deans and systems users group (about ten members, total). The purpose--discussion, not of hard operational events, but the eliciting and disseminating of soft data/information/issues. The weekly meetings of the senior administrative staff serve, in part, the same function.

While these activities are not generally a part of any computer file, needs and resources identifications are enhanced.

Observations and Conclusions

A major reason for stressing the presence of objectives prior to going on with an information needs analysis is their availability for use as input in assessing the level of management anticipated (according to stated objectives) by the organization. This procedural methodology minimizes the likelihood of individuals in our profession designing and developing a management information system when the organizational objective(s) call for administrative information system (see figure 4), or some degree of hybridization.

From the Gardner/Parker article and the materials referenced in the Chronicle of Higher Education, universities appear more to manage well day-to-day, i.e., procedures/resources, than to plan or project effectively.

But it is clear that forms of management and planning do take place and while it is likely there is no ideal or average mix of hard and soft support data/information, there likely is an ideal combination for a specific institution or organization. In none of the materials reviewed was found an individual or organization using 100 percent hard or soft source data, or utilizing a 100 percent management or a 100 percent administrative approach to objectives meeting. At Pepperdine University, we use hard data for tracking purposes, e.g., enrollments, budget, personnel turnover, etcetera, and a combination of hard and soft information for planning purposes. We do not have elaborate systems resources for getting as sophisticated as many need or want to get in either tracking or planning, but the resource(s) seem adequate for our institution as we approach 1980. Since we have developed no optimum system "shelf life," since systems are not covered in our retention schedules, and since most of the planning/design work for the integrated elements of our system were planned and designed in 1975 and 1976, we feel the MIS/AIS model mix at Pepperdine University has been successful.

In summary, the following points seem worth reviewing:

(1) The typical MIS is based on Fayol's 1916 definition of the functions of management.

(2) Businesses as well as universities have had their share of MIS woes, therefore, lack of "businesslike" management practice by universities is not the reason for MIS problems.

(3) A different look at what managers do, i.e., Mintzberg, leads to a different view of MIS design.

The authors would suggest:

(4) Establishment of information objectives for the institutions.

(5) Using the objectives, determine type (data or decision) or mix of data/information needs analyses to be conducted.

(6) Conduct such analyses.

(7) Design and develop the information system that is "right" for the institution/situation.

Gook Luck!

FOOTNOTES

[1] Katch, David, "What is a Management Information System?," Infosystems, June 1978, p. 94.

[2] Drucker, Peter F., Management: Tasks, Responsibilities, Practices, Harper and Row, New York, 1974, p. 400.

[3] Katch, pp. 94-96.

[4] Spencer, William I., "What do Upper Executives Want From MIS?," Administrative Management, July 1978, p. 26.

[5] Ibid., p. 27.

[6] Fedewa, Lawrence J., "How Efficient Are Colleges?," The Chronicle of Higher Education, November 20, 1978, p. 48.

[7] Gardner, Don E. and Parker, John D., "MIS in Higher Education: A Reassessment," CAUSE/EFFECT, May 1978, pp. 10-13, 16, 17.

[8] Powers, Michael J., "A Management Information System for Academic Administrators," AEDS Journal, Summer 1978, pp. 97-106.

[9] Fedewa, p. 48.

[10] Mintzberg, Henry, "The Manager's Job: Folklore and Fact," Stress, Success...and Survival, Harvard Business Review, 1976, pp. 111-123.

[11] Ibid., pp. 116-121.

[12] Ibid.

[13] Munro, Malcolm C., "Determining the Manager's Information Needs," Journal of Systems Management, June 1978, p. 34.

[14] Katch, pp. 94, 96, 98.

[15] Kneitel, Arnold M., "The Futility of User Involvement," Infosystems, November 1978, p. 92.

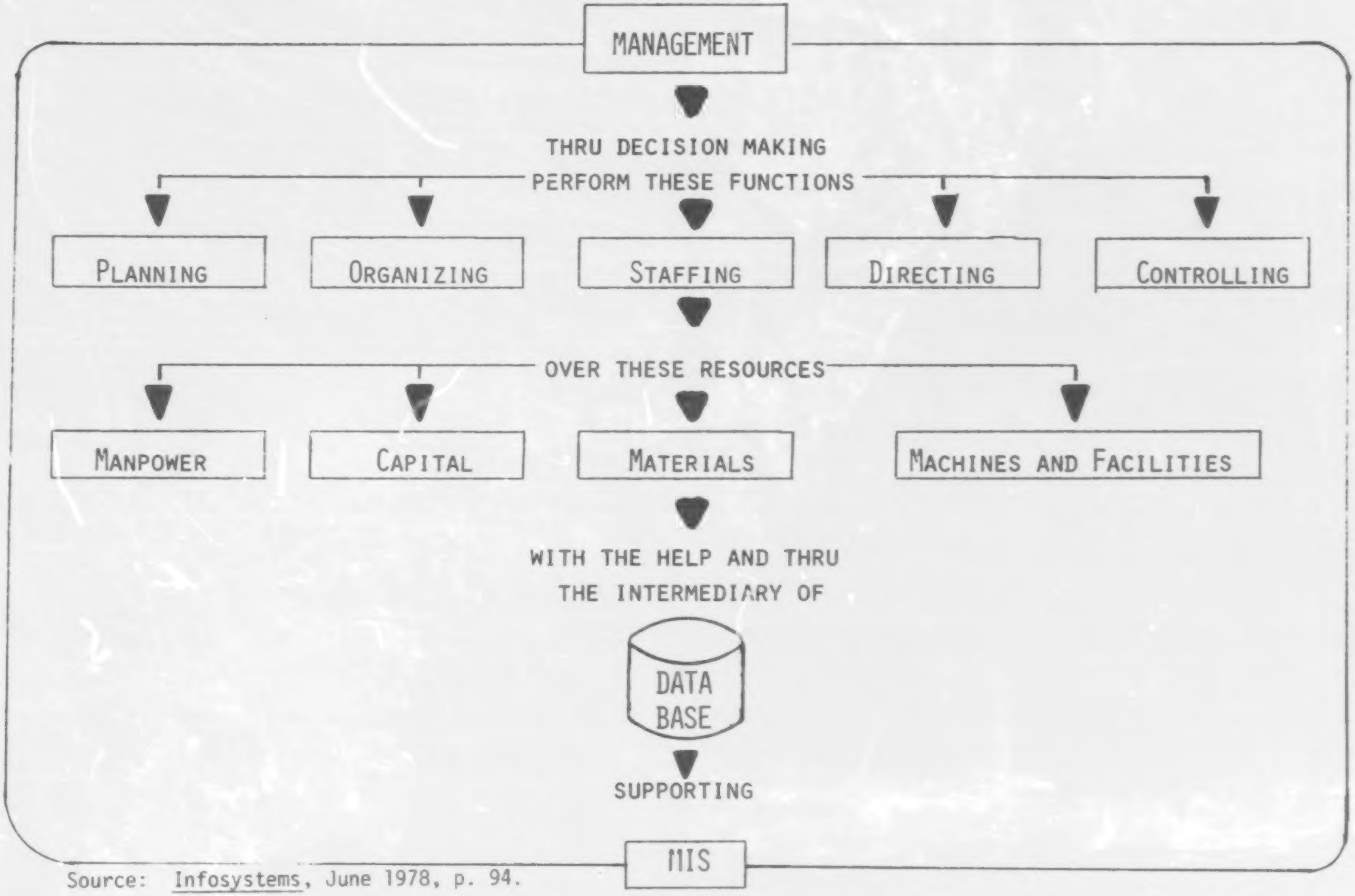
[16] Mueller, George E., "Blueprinting a Workable MIS," Administrative Management, September 1978, p. 25.

[17] Penrod, James I. and Craft, Larry N., "Thinking New System(s)? Some Action Items," CAUSE/EFFECT, September 1978, p. 18.

[18] Spencer, p. 68.

[19] Mintzberg, p. 114.

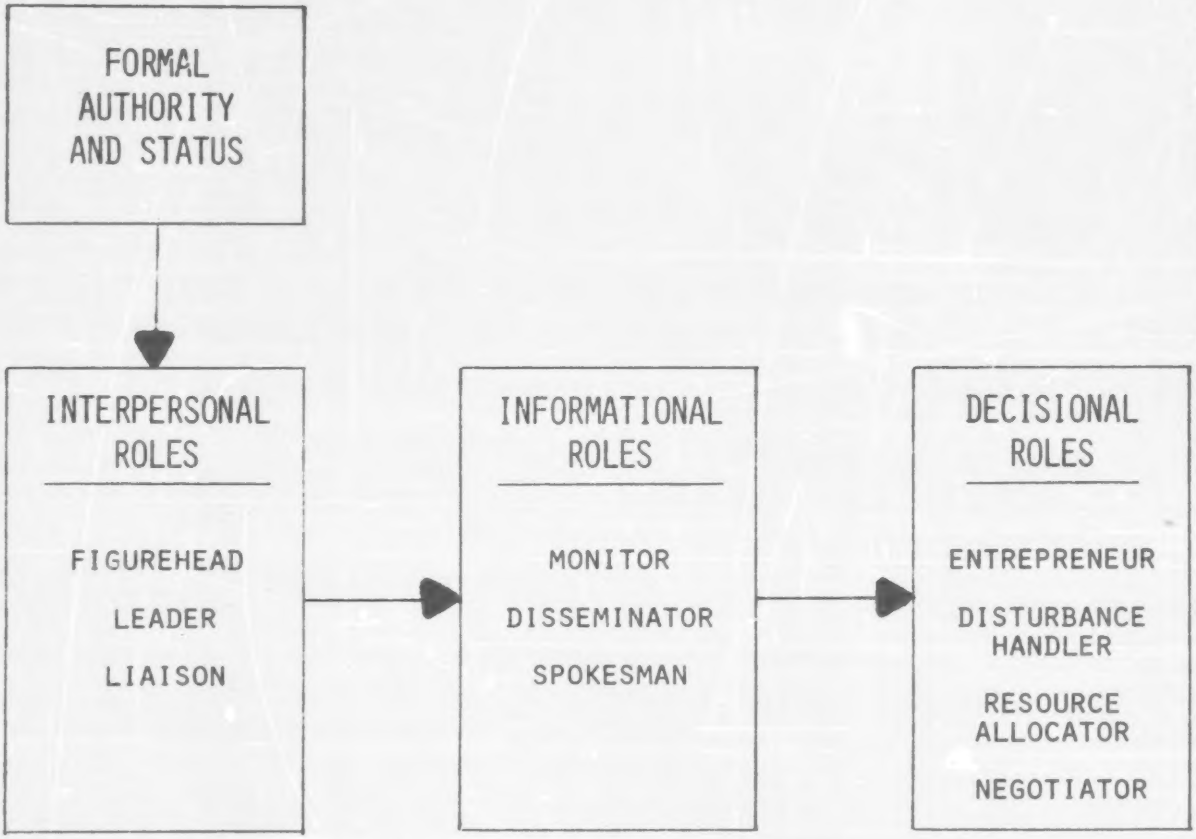
Appendix - Figure 1



Source: Infosystems, June 1978, p. 94.

Appendix - Figure 2

THE MANAGER'S ROLES



Source: Stress, Success...and Survival, Harvard Business Review, 1976.

APPENDIX - FIGURE 3

A. DATA ANALYSIS METHOD

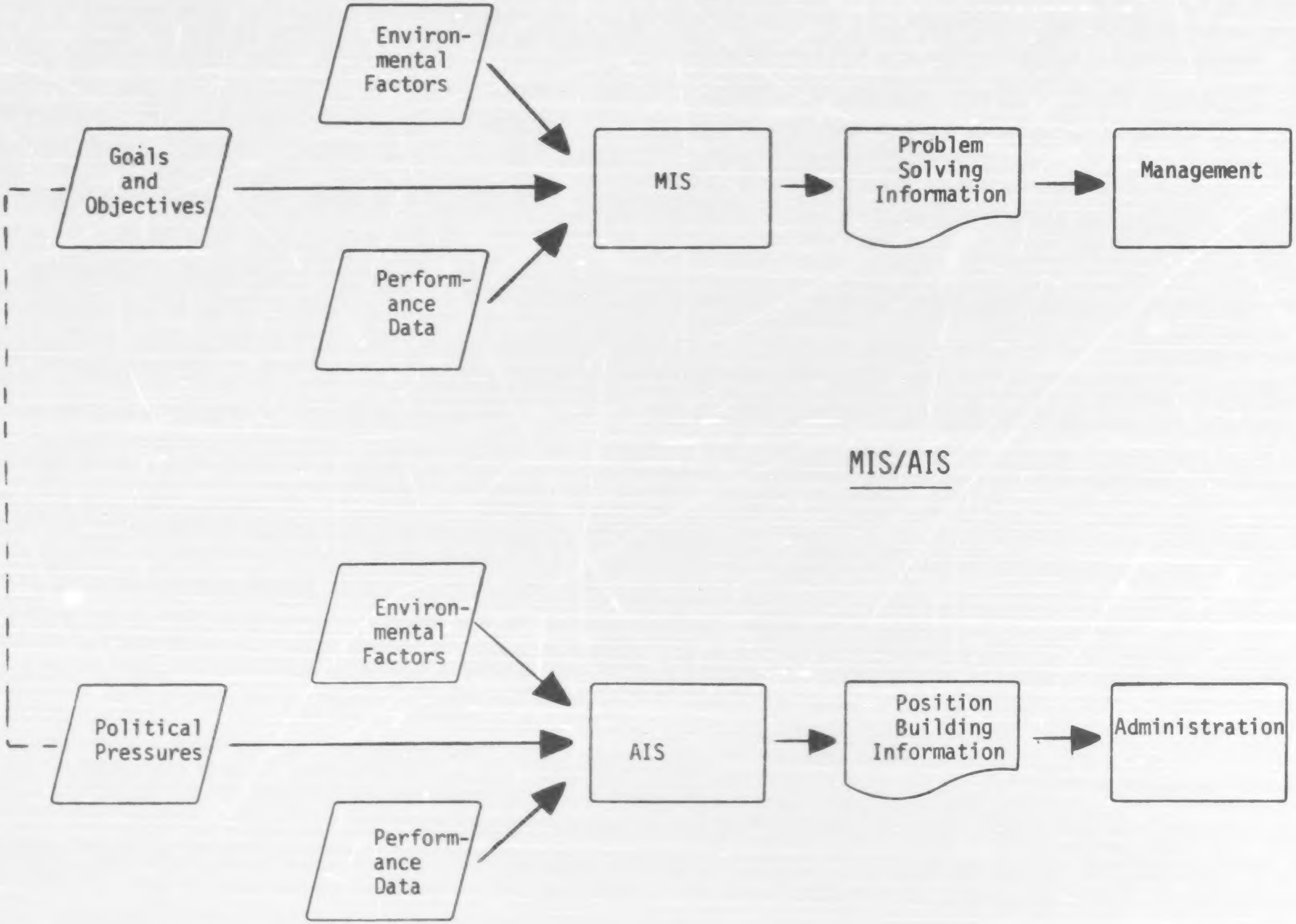
1. EXAMINE ALL REPORTS, FILES, AND OTHER INFORMATION SOURCES DRAWN UPON BY THE MANAGER.
2. DISCUSS WITH THE MANAGER THE USE OF EACH PIECE OF INFORMATION EXAMINED.
3. ELIMINATE UNNECESSARY INFORMATION.
4. DETERMINE UNSATISFIED INFORMATION NEEDS THROUGH INTERACTION WITH THE MANAGER.

B. DECISION ANALYSIS METHOD

1. DETERMINE MAJOR DECISION RESPONSIBILITIES THROUGH DISCUSSION WITH THE MANAGER.
2. DETERMINE POLICY AND ORGANIZATIONAL OBJECTIVES RELEVANT TO DECISION AREAS IDENTIFIED.
3. DETERMINE SPECIFIC STEPS REQUIRED TO COMPLETE EACH MAJOR DECISION.
4. DEVELOP A MODEL (FLOW CHART) OF EACH DECISION.
5. EXAMINE FLOW CHART TO DETERMINE INFORMATION REQUIRED AT EACH STEP IN THE DECISION.

SOURCE: JOURNAL OF SYSTEMS MANAGEMENT, JUNE 1978, PP. 35, 36.

Appendix - Figure 4



Source: CAUSE/EFFECT, May 1978, p. 17.

CASPER: "COMPUTER ASSISTANCE FOR STUDENTS PREPARING TO ELECT COURSES FOR REGISTRATION"

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William Starkweather
Project Manager
Special Designs

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CASPER is, in essence, a subject matter index to available courses offered at the University each semester. This system is a completely interactive on-line tool which provides the student with continually updated information in an interesting manner and complements many of the counselor's functions. In particular, the difficult function of organizing and disseminating vast amounts of accurate data during the preregistration, scheduling and add/drop periods, which cannot be accomplished satisfactorily with the traditional course catalog and course description guide, is overcome with this on-line system. CASPER analyzes a student's course selection criteria and returns not only an inventory of courses which meet that criteria and data needed to register, but also supplies decision-making information such as prerequisites, audience type, instruction format, instructor's name and whether the section is currently open, closed or reopened. The student's criteria may include up to six subject matter keywords, a range of starting times, the first day of the week on which course sections meet and finally, if applicable, the core requirements satisfied.

By employing a unique file structure and search method, the CASPER system responds rapidly to student requests. Using the system's faculty generated keyword and synonym dictionary, this completely interactive on-line system helps the students make a rational course choice in support of their career direction.

CAREER GUIDANCE OVERVIEW

In 1976 representatives from both the Provost's and the Vice Chancellor for Student Affairs' offices, with the support of the Office of Management Systems, began formulating a plan to develop a totally integrated computer-based career guidance system. Intentions were to develop a total system that when completed would aid students with career guidance support from pre-admissions counseling through job placement for seniors and alumni. The system would also include meaningful career directed guidance in work student matching, i.e., student employment, counseling students in selection and changing of their majors and course registration. Development of the total system's components has been slowed due to; higher priority tasks imposed on many of the offices involved, limitation of resources for higher education in a financially troubled State, and the abnormal organizational flux caused by an almost total turnover in the top twenty five administrative positions ranging from President to Associate Vice Chancellor.

The job placement and work student matching systems have recently been completed. However, it was the CASPER system which was first to be implemented and functions today as a stand alone system, yet to be employed in its potential use of tying together the other functioning components of the career guidance system.

CASPER OVERVIEW

The initial concept of the CASPER system, i.e., a subject matter index to available courses offered at the University each semester, was designed by a student as an honors project and tested on a limited basis at the academic computer center. The availability of a tested concept, the active support by an Associate Dean of the College of Arts and Sciences and the Dean of Students in the form of both financial resources for analysis and programming, and time allocation of their staff made CASPER a reality. More important however was the foresight of all concerned that it was possible to perfect and implement quickly, once development began, this segment of the career guidance system for its immediate use by the 35,000 students currently enrolled at the University of Massachusetts.

With the exception of some investigation into vendor available career guidance packages and initial discussions with the guidance staff in the College of Arts and Sciences, development of the current CASPER system did not begin until July, 1977. The system, although not completely documented, was available for student use during preregistration in mid October. While two analysts carried most of the development burden, three support staff were available when needed and the two administrators involved were concerned primarily with the politics of bringing up a multi user system. The functional effort was distributed as follows:

Analysis	9%
Design	34%
Programming and Testing	22%
Documentation and User Training	25%
Support Tasks	3%
Administration	7%

The CASPER system was developed on an IBM 370/155 and currently runs on our ITEL AS/6 mainframe. There are approximately 140 terminals, the majority of which are IBM 3270 units. Software includes an OS/VS1 operating system, with a CICS teleprocessing monitor and all programs are written in COBOL. The CASPER system itself includes seven batch programs, four CICS modules, two teleprocessing screen formats and requires maintenance of two files and a keyword-synonym dictionary. The two files are a course file, which is created and updated as a sequential file that is then converted to VSAM organization, and a non-recognizable-word log file, both of these files are VSAM key-sequenced data sets. The keyword-synonym dictionary is maintained as a sequential tape file and installed as source code in one of the CICS modules.

When CASPER was implemented considerable effort was directed to user training. Assistant student counselors were trained in the operation of the terminals and the system. A short training guide entitled "USING CASPER" (see Appendix I) was liberally distributed. The intention was to always have a student counselor interface between student and system. By the second day it was obvious this precaution was not necessary and students began availing themselves of the unattended system which attests to CASPER's interactiveness. Initially the system was available only on the guidance office terminal in the College of Arts and Sciences. Today however it is available at terminals in the offices of Admissions, Transfer Affairs, Registrar, Veterans Affairs, Financial Aid, Dean of Students, Provost, Chancellor and any other administrative terminal when requested by the user.

CASPER SYSTEM DESCRIPTION

Introduction

CASPER is, in essence, a subject matter index to available courses offered at the University each semester. This system is a completely interactive on-line tool which provides the student with continually updated information in an interesting manner and compliments many of the counselor's functions. In particular, the difficult function of organizing and disseminating vast amounts of accurate data during preregistration, scheduling and add/drop periods, which cannot be accomplished satisfactorily with the traditional course catalog and course description guide, is overcome with this on-line system. From the faculty point of view CASPER helps enroll students in the right courses by matching offerings and interests. This in turn diminishes the drop/add load. The system also collects requests for courses not offered, thus providing suggestions for curriculum-building. Using the system requires no training and the dialogue between students and the system can be best described with the illustrations shown in the section entitled "USING CASPER - THE STUDENTS' VIEW."

Casper Course File Date

Creation of the CASPER course file requires data supplied by individual faculty members and data extracted from the University's course master schedule file. Each semester faculty are asked to complete a Faculty Course Description Form (see Exhibit A) that describes the courses, i.e., more precisely course sections, they will teach the following semester. This predominantly descriptive information furnished by the faculty includes the audience for whom the course is intended, i.e., majors, non-majors or both, one of ten possible instruction formats, the instructor's name, any prerequisite course the instructor deems necessary or their permission, and up to six keywords from the supplied Dictionary (see Exhibit B) that describe the course subject matter.

Since the faculty survey is completed before the University's official course master file has been "fixed" and the resulting schedule booklet goes to the printer, scheduling changes may occur. To insure a positive sync between all course information made available to students, scheduling data is extracted from the course master file immediately after the printer's copy has been produced and is combined with the faculty data already on the CASPER course file. The data extracted from the course master file includes the course schedule number, the starting day (first day class meets), starting time (hour), meeting time (long version for display purposes, e.g., TUTH 9:30-11:00), course credits, distribution area (graduation core requirements) and the course description.

CASPER Course File Organization - Dictionary and Search Procedure

The CASPER course file is organized with a dictionary, which is a subset of English. The dictionary is composed of keywords and synonyms with each word limited to twelve letters (see Exhibit C). Keywords are important concepts used by the faculty to describe course content, while synonyms are alternate forms, synonyms or subsidiary concepts of keywords and allow CASPER to understand the forms of a concept appearing most often in speech and writing. For a complete discussion of the dictionary see the section entitled "CASPER DICTIONARY AND DICTIONARY MAINTENANCE." Each keyword in the dictionary is assigned a four digit number and synonyms are connected to one and only one keyword by the same number. This keyword number is used in constructing the key of the course's records in the CASPER course file.

Each course on the file has as many records as there are keywords that describe it, i.e., from one to six. The record's key includes all the keyword numbers, once with each keyword number in the high order four digits of the key and followed in ascending order by the remaining keyword numbers. Each record's key is obviously different since a different keyword number is first. For example a course described by keywords 0005, 0078, 0113, 0849, 0982, 1203 would appear with the record's keys:

```
000500780113084909821203
007800050113084909821203
011300050078084909821203
084900050078011309821203
098200050078011308491203
120300050078011308490982
```

Thus CASPER can look up a course using any keyword number, see the section entitled "CASPER SEARCH TECHNIQUE" for a complete discussion of the procedure. Moreover, when the course file is created, the number of occurrences of each keyword is recorded in its dictionary entry and a frequency distribution report is printed (see Exhibit D). Having this information, CASPER can look up a course using the rarest keyword's number and therefore in the limiting case will read the file as few times as possible to determine that a set of keywords and synonyms cannot be satisfied. One of the records created for each course is specially tagged and is called the primary record. The search order by which the CASPER course file is queried is keywords, starting day, starting time and distribution area. When CASPER is asked to find courses without being given keyword criteria only primary records are examined to see whether they fit the other descriptive criteria. The last primary record, i.e., the record having the highest key, is uniquely tagged so that a sequential search of the file stops there.

CASPER Input/Output Teleprocessing Screens

The CASPER system uses two teleprocessing screen formats: one input transaction screen upon which the student types the descriptive selection criteria of their desired course(s) and a course data output screen that contains information about the course(s) found. Both of these screens contain complete instruction as to possible inputs and their required formats. Also error messages relative to prohibited or inadmissible input are accompanied by corrective instructions making this indeed an interactive system, see the section entitled "USING CASPER - THE STUDENTS' VIEW."

The input transaction screen (see Exhibit E) accepts course description criteria including up to six keywords associated with the course subject matter, a range of class starting times (hours), the day of the week on which the course first meets and the distribution area (graduation core requirements) it satisfies.

The course data output screen (see Exhibit F1) displays course information for six courses at a time. Information for a maximum of eighteen courses can be stored. This information includes department name, course and section number, descriptive title, instructor's name, instruction format, area distribution (core requirements), and schedule number on the first line and the long version of meeting times, i.e., TUTH 9:30-10:45, prerequisites if appropriate, course credits and audience type on the second line.

CASPER - Log File and Course Closing

Whenever CASPER is presented an unknown term in the keyword area of the input transaction screen, i.e., a term that cannot be found in its dictionary, the term is recorded in the system's non-recognizable-word log file. Each night during preregistration, scheduling and add/drop periods and at lesser intervals during other periods, a list is printed of unknown terms and the frequency with which they are presented to CASPER. The log file is then purged in preparation of the next day's transactions. The initial preparation of the CASPER system for use during a semester begins with a review and update of the dictionary which is motivated partly by a study of the keyword frequency counts from the course file and the non-recognizable-word log file listings. These listings may also provide suggestions to be used in curriculum-building.

After preregistration, i.e., at the end of each scheduling run, courses that are filled to their designated capacity are closed and indicated on the CASPER course file records by replacing the instructor's name with the legend "*****CLOSED*****". Each night during the add/drop period additional courses may be closed and currently closed courses reopened by deleting the closed legend.

The end of add/drop period closes the CASPER processing cycle. However, the system is continually up and available for use by the University community throughout the semester.

USING CASPER - THE STUDENTS' VIEW

Introduction

CASPER analyzes a student's desired course selection criteria which may include up to six subject matter keywords, a range of starting times, the first day of the week on which course sections meet and finally, if applicable, the core requirements satisfied. The system returns not only an inventory of courses which meet the criteria and data needed to register, but also supplies decision-making information such as possible prerequisites, audience type, instruction format, instructor's name and whether the section is currently open, closed or reopened.

CASPER is indeed an interactive system conversing with the student user by offering complete instructions as to possible inputs and their required formats and by supplying definitive messages relative to prohibited or inadmissable input which is accompanied by corrective instructions. By employing a unique file structure and search method, the system responds rapidly to student requests. Using the system's faculty generated keyword and synonym dictionary, this completely interactive on-line system helps the student make a rational course choice in support of their career direction.

The students can use the system as they would the course catalogue. That is, looking up courses associated with a single discipline by using one keyword to describe the course content, e.g., journalism or english or physics. Employing CASPER in this manner, i.e., as pseudo on-line course catalogue, was not the primary intention for developing the system. Instead the system is intended to be used as a cross discipline search for available courses which satisfy desired subject matter parameters, e.g., courses described by keywords film-woman-liberature-history, coupled with its ability to function as a scheduling tool.

Student-System Interaction

To begin interacting with the system our student merely types "CASPER" on the terminal keyboard and presses the ENTER key. CASPER responds with an input transaction screen (see Exhibit E). The selection criteria fields are displayed and accompanied by instruction at the top and bottom of the screen relative to the format of the inputted selection criteria and transmittal procedures. Our student immediately attempts to use the system as a pseudo on-line course catalogue by entering keyword 1: JOURNALISM and pressing the ENTER key.

CASPER after searching the file finds fifteen courses which meet the student's needs and displays the first six courses on the course data output screen (see Exhibit F1). The first line contains the department name, course and section number, course title, instructor's name, course format, distribution area and schedule number under the appropriate headings. The second line furnishes the meeting time, prerequisites if any, course credits and audience type, i.e., majors, non-majors or both. Since CASPER found fifteen courses meeting the criteria, these courses are stored and can be displayed as shown in Exhibits F2 and F3. At the top of the screens the number of courses that meet the criteria is displayed, while at the bottom of the screens CASPER asks for instructions relative to displaying the next page by typing "N" or the previous page by typing "P". At any time, regardless of which course data output screen is being displayed, the student can return to the input transaction screen for review or modification of the course selection criteria.

Some casual observations by our student of the output screens discloses that entering a single keyword discipline name has not resulted in a listing of solely journalism courses, which attests to the cross discipline value of the CASPER system. Furthermore from Exhibit F1 the student observes that course COMSTU 121 has a core distribution area "D", that indeed course sections as opposed to courses are displayed as evident by JS 200 sections 2 and 3, and that course JS 200 section 3 illustrates a closed course where the instructor's name has been replaced by the legend surrounded by stars. Likewise Exhibit F2 displays a course, JS 392A 1, which has two prerequisites: both course JS 200 and the permission of the instructor. Finally, Exhibit F3 displays two courses, with meeting times by arrangement, for variable course credits.

Cross Discipline Searching

Since the primary intention in designing the CASPER system was to extend to students a cross discipline searching of available courses that satisfy their desired subject matter, we next observe the coed communications major at the next terminal. This student has just entered journalism, media and film as her keywords (see Exhibit G). The student could have used an array of synonyms from the system's dictionary that allow CASPER to translate the forms of a concept appearing most often in speech and writing as alternate selection criteria. For journalism the student could have entered reporting, newspaper, press or journal. While broadcasting, radio or TV are acceptible substitutes for media and film making, movie or cinema for film. All of these synonyms would have resulted in the Communication Studies course entitled "History and Development of Motion Pictures" shown in Exhibit H.

Our coed varies her investigation of film making on her second attempt by entering the keywords film, literature, history and woman (see Exhibit I) with the resulting two courses displayed in Exhibit J. It should be noted that journalism and media could have been added to this last search with the same Communications Studies course resulting from her first search.

Scheduling Criteria Searching

The next student to visit the CASPER terminal has a particular need, that of filling a time slot on Tuesday and Thursday with a course that satisfies a graduation core requirement in his area of study. Entering the selection criteria shown in Exhibit K he is quickly supplied four courses with varying content to choose from. Should none of these courses satisfy his desired needs he may wish to expand the range of course meeting times.

Interactive Messaging

The last student to use CASPER allows the system to emphasize its interactiveness. Having entered a rather non-restrictive set of selection criteria he obtains the result (see Exhibit M) that more than eighteen courses satisfy his criteria. As most students are willing to please, he overzealously adds as subject matter criteria "Science" and "French Revolution", expands the range of course starting time, designates a first meeting day and distribution area, all with the devastating result shown in Exhibit N. Realizing that he has communicated with CASPER and CASPER with him, although frustrated, he is willing to continue. Correcting his spelling error in Science and noting that only the first twelve letters of a keyword are legitimate, he enters "French Rev." Erasing the overflow on the last keyword and correcting the first meeting day criteria, he is ready to finish his corrections posthaste, by selecting a distribution area "C" which he seems to remember as appropriate and expanding the starting range to twenty four hours so as not to eliminate any possible courses. All these actions result in his facing the entanglements shown in Exhibit O. Realizing that CASPER has no interest in the French Revolution, this keyword is quickly deleted and the starting time is set back to eight o'clock where it had been accepted without error. This readmission of altered selection criteria has the result shown in Exhibit P. The student not knowing how late "too late" is deletes the meeting time criteria completely and finally has an error free transmission. Unfortunately, his course selection criteria is now too restrictive (see Exhibit Q). In final desperation and with his head resting on the space bar he eliminates all remaining scheduling criteria and with a last gasp presses the ENTER button. He has finally met success as shown in Exhibit R when the course "Science and Creative Intelligence" is displayed.

Although over exaggerated, but not too far from real situations, this scenario demonstrates the interactive properties of the CASPER system. For a complete listing of the system's interactive messages, see Appendix I.

CASPER DICTIONARY AND DICTIONARY MAINTENANCE

CASPER Dictionary

When a list of subject matter keywords describing a desired course is presented to the CASPER system, it looks each word up in its dictionary. The dictionary supplies information relative to where on the CASPER course file courses can be located that satisfies the selection criteria and keyword frequency occurrences needed by the search process. There are two types of entry in the dictionary: keywords and synonyms.

Keywords are important concepts used in describing course subject matter. In order to apply to as many courses as possible, keywords are the most general form of a word: as a rule, nouns rather than adjectives or verbs and abstract nouns rather than common nouns or proper nouns. Thus one would choose imperialism instead of imperial, management instead of manage, and nursing instead of nurse. The faculty are only given keywords to choose from in describing their courses.

Synonyms are alternate forms, synonyms, or subsidiary concepts of keywords. They are defined by one and only one key word. When CASPER is given a synonym, it looks up its definition and selects courses that are described by the definition. Synonyms allow CASPER to speak English. Well-chosen sets of synonyms let CASPER understand the forms of a concept appearing most often in speech and writing--adjectives (natural for nature), verbs (speak for speech), plurals (birds for bird), alternate forms (USSR for Soviet Union), synonyms (disability for handicap), subsidiary concepts (court for law), even alternate spellings (behavior and behaviour).

Keywords and synonyms are limited to twelve letters in order to conserve computer resources. Keywords are truncated rather than abbreviated because not everyone abbreviates a term in the same way. Keywords and synonyms can contain more than one word, and such compound entries may have to be truncated to phrases like "FOREIGN POLI" and "PHYSICAL EDU." A compound keyword or synonym is best discarded if it is ambiguous; for example, constitutional law would be impossible to distinguish from constitution once truncated. Spaces between words count as letters.

Dictionary Maintenance

The CASPER processing cycle is a semester in length. It begins with a review and update of its dictionary which is motivated partly by a study of the keyword frequency counts and the resulting lists of the non-recognizable-word log file. The updating is in the form of adding new entries requested by the faculty and students, removing entries that are no longer used and modifying synonyms. New terms may become keywords or synonyms or supplant existing keywords. In the last case, the new keyword is added, the older keyword is deleted and may be added as a synonym, and all of the older keyword's synonyms are redefined. One should be cautious in adding synonyms--if the keyword and synonym are merely related, CASPER will be unable to find courses described by the synonym. For example, aviation and flight are closely related. Nevertheless, making flight a synonym for aviation would prevent CASPER from finding courses concerning bird or insect flight because zoology and entomology faculty would not choose aviation as a keyword for their courses. Adding keywords has its perils too; a new keyword must be distinct from existing ones lest it capture part of an existing keyword's courses and reduce students' choices.

After the review of the dictionary is complete, the changes are coded on a special form (see Exhibit S). From this sample form one can see the different steps necessary to supplant an existing keyword (WOMAN) with a new term (WOMEN): line 1 keyword WOMAN deleted, line 2 new keyword WOMEN added, lines 3 synonym WOMENS STUDI redefined by WOMEN and line 9 a new synonym WOMAN defined by WOMEN is added. The dictionary update produces three reports: a new dictionary listing, a report of changes made to the dictionary and an error transaction report. When an errorless dictionary is obtained the keywords from the new dictionary listing are printed on the course description form sent to faculty midway through the semester for their description of courses they will teach the following semester.

CASPER SEARCH TECHNIQUE

Each course on the CASPER course file has as many records as there are keywords that describe it, i.e., from one to six,--once with each keyword number in the high order four digits of the key, with the other keyword numbers following in ascending order. Thus a course described by keywords 0005, 0078, 0113, 0125, 0161, and 0222 would appear with the keys:

```
000500780113012501610222
007800050113012501610222
011300050078012501610222
012500050078011301610222
016100050078011301250222
022200050078011301250161
```

When a list of keywords describing a course is presented to CASPER, it looks up each keyword number and the number of courses in its file described by that keyword. The system picks the keyword occurring the fewest times and sorts the rest of the keyword numbers in ascending order. It issues a generic read of the course file using the rarest keyword's number. If a record is found CASPER compares the second keyword number in the record's key to the second keyword number in the sorted list. If the keyword number from the course record is larger, the match fails because the keyword number in the sorted list cannot be among the keyword numbers in this record key. If the sorted list contains six keywords and the keyword number from the record key does not match the keyword number from the list, the match fails also. If the keyword numbers match, the next from the sorted list is compared to the next from the record key. If the keyword number from the course record is smaller, the next from the file is compared to the same keyword number from the sorted list. The process is repeated until CASPER determines whether the keyword numbers in the sorted list are all in the record key. If the course record key contains every keyword number in the sorted list, CASPER compares the starting day, starting times, and core requirements (distribution area) presented to it from the terminal with the day, time, and core in the record. If all match, the course is put into a course table that holds up to eighteen courses. CASPER continues to read the course file sequentially until the first keyword number in the record no longer matches the rarest keyword number of the selection criteria or the course table overflows. Each record is compared to the keyword selection criteria list as described above.

One of the six possible records for a course--the one with the lowest keyword number first--is called the primary record. If CASPER is asked to find a course without knowing any keywords, it scans through the file sequentially, comparing only the primary records to the criteria presented to him. Such a search will often be ended by course table overflow. If there are 1200 courses and 500 keywords, the average search involves one seek, twelve or less reads, and 72 or less comparisons. A search without keywords could read the whole file; in order to make this less likely CASPER validates time and core before beginning a search. Multiple seeks are unlikely because there are 304 course records per cylinder and the average keyword frequency is only 12.

EXHIBIT A: FACULTY COURSE DESCRIPTION FORM

September 1978

TO: Faculty Teaching Introductory and Intermediate Courses
FROM: CASIAC, James W. Shaw, Director
SUBJECT: CASPER

Once again we are asking for your help in compiling information for the computer program known as CASPER (Computer Assistance for Students Preparing for Early Registration).

This program, designed initially as an Honors project by one of our students and since perfected by Management Systems, enables our students to:

1) Find courses which treat any of the topics or combination of topics which you circle on the back of this form. In this sense, CASPER serves as a sort of subject-matter index to the Course Description Guide; and/or
2) Find courses which count toward satisfaction of the B, C, D, or E requirement; and/or
3) Determine, during the early days of each term, whether a course is open or closed. In fact, CASPER can generate printed lists of open and closed courses.
4) Find courses which meet at a given time. In particular, older students can identify courses which meet at hours convenient for them. During pre-registration, students can put together an efficient schedule, or at the beginning of a term students who have not received a full schedule from the computer can find desirable courses to fill out their schedule.

For faculty, CASPER can also be of assistance:

1) It helps enroll the right students by matching offerings and interests;
2) It thus cuts down on dropping and adding;
3) It collects requests for courses not offered, thus providing suggestions for curriculum-building;
4) It provides advisors with lists of open and closed courses.

Since most of the information we need to operate CASPER is taken from the existing Course Master list (e.g., distribution area and schedule number), you need only fill in the information requested below and on the back. Please:

1) Submit a form for each section of each 3 or 4-credit course you teach at the 100, 200, or 300 level, and any 400-level courses which you believe might appeal to a general audience;
2) On the back of this form, circle up to 6 topics which characterize your course's content.
3) If the content or meeting time makes this course particularly suitable for older, non-traditional students, please circle CAOS (Counseling Assistance for Older Students).
4) Return this form to your departmental office along with your forms for the Course Description Guide.

If you have any questions or problems, please contact Sandie Pirrello, 5-2191.
If you would like to see CASPER in operation, visit CASIAC, Machmer E-20.
Thank you very much for your help.

COURSE TO BE OFFERED DURING SPRING SEMESTER 1979:

☐☐☐☐☐☐	☐☐☐	☐	☐☐☐
1. Department	2. Course Number	3. Suffix, if any (e.g., H for Honors)	4. Lecture Section (required entry. e.g., 001, 09A, 010, etc.)

5. Descriptive Title ____________________

6. Instructor's Last Name, Initial(s) ____________________

7. Audience Code ☐

"M" - Majors
"N" - Non-majors
"B" - Both

8. Day of Class Meeting (circle first day class meets)

M T W Th F S

9. Instruction Format ☐

"L" - Lecture
"B" - Lecture and Discussion
"C" - Lecture and Laboratory
"E" - Laboratory
"S" - Seminar
"D" - Discussion
"I" - Independent Study
"F" - Field Work
"A" - Studio
"W" - Workshop

10. Time Class Begins: ____________

11. Pre-requisite: Enter:
a) Department and Number of a course, or
b) "Permission" if instructor's permission is required, or
c) Leave blank, if there is no pre-requisite.

☐☐☐☐☐☐☐☐☐☐

12. ____________________
Cross-Listed With?

EXHIBIT B: KEYWORD DICTIONARY

Circle 6

Abnormal
Accounting
Acid
Adaptation
Adjustment
Administration
Adolescence
Advanced
Advertising
Aerospece
Africa
AfroAmerican
Aggression
Agriculture
Agronomy
Algebra
Algorithm
America
Analysis
Anatomy
Ancient
Animal
Anthropology
Archaeology
Architecture
Art
Art History
Asia
Astronomy
Atmosphere
Atom
Attitude
Austria
Autobiography
Avant-Garde
Bacteria
Ballet
Behavior
Bible
Bibliography
Biochemistry
Biology
Biophysics
Botany
Brain
Britain
Buddhism
Business
Byzantine
Calculus
Calligraphy
Canada
CAOS
Capitalism
Carbohydrate
Carbon Comp
Cell
Central Amer
Ceramics
Ceremony
Change
Chef
Chemical Eng
Chemistry
Child
Child Abuse
China
Civics
Civil Eng
Civil Rights
Civilization
Class
Classics
Coaching
Coal
Cognition
COINS
Colonialism
Colony

Color
Comedy
Communication
Communism
Community
Comp Lit
Comparative
Composition
Comprehension
Computer
Conflict
Consciousness
Conservation
Constitution
Consumer
Contemplation
Contemporary
Control
Conversation
Cosmos
Counseling
Crime
Crisis
Criticism
Culinary
Culture
Cybernetics
Dance
Data
Death
Debate
Decision Mak
Democracy
Design
Detectives
Development
Differential
Diplomacy
Discrimination
Disease
Disorders
Drafting
Drama
Drawing
Drug
Drying
Dutch
Earth
East
Ecology
Economy
Editing
Education
Electricity
Electron
Elementary
Empiricism
Employment
Energy
Engineering
England
English
Entomology
Environment
Equitation
ESL
Estimation
Ethics
Ethnic
Etymology
Europe
Evolution
Exercise
Existentialism
Experiment
Family
Fantasy
Fascism
Feminism

Fertility
Fiction
Film
Finance
Flight
Floriculture
Folklore
Food
Food Service
Foreign
Foreign Policy
Forestry
France
Freedom
Freud
Frontier
Function
Game
Gene
Geography
Geology
Geometry
German
Gerontology
Ghosts
Government
Grammar
Graph
Gravity
Greece
Group
Growth
Handicap
Health
Hearing
History
Homer
Horticulture
Hotel
Housing
Human
Humanism
Humanities
Hypothesis
Ichthyology
Ideology
Imperialism
Income
India
Indian
Inequality
Institution
Instrument
Integration
Intelligence
Interaction
International
Interpretation
Introductory
Invertebrate
Ion
Ireland
Islam
Italy
Japan
Jargon
Jewelrymaking
Journalism
Judaism
Justice
Kilns
Kinetics
Knowledhe
Korea
Labor
Land
Landscape
Language
Latin

Latin Amer
Law
Leadership
Learning
Leisure
Library
Limit
Line
Linguistics
Literature
Lodging
Logic
Lying
Magic
Magnetism
Mammal
Management
Map
Mapping
Marine
Marketing
Marx
Massachusetts
Material
Math
Mechanics
Media
Medicine
Medieval
Memory
Metabolism
Methods
Microbe
Mideast
Migrate
Military
Mineral
Minority
Molecule
Morphology
Motivation
Movement
Muscle
Museum
Music
Mutation
Mycology
Mysticism
Myth
Nation
Natural Sci
Nature
Near East
Nerve
Neuroscience
New England
Note Taking
Novel
Nucleus
Nursing
Nutrition
Occupation
Ocean
Old Age
Oppression
Optics
Organic
Organization
Ornithology
Painting
Pathology
Peace
People
Perception
Performance
Personality
Personnel
Persuasion
Pesticide

Petroleum
PH
Philosophy
Phonetics
Physical
Physical Ed
Physics
Physiology
Planning
Plato
Poetry
Poland
Policy
Political Sci
Politics
Pollution
Popular Cult
Population
Portugal
Poverty
Practicum
Prejudice
Preparation
Presidency
Primate
Primitive
Printmaking
Probability
Process
Pronunciation
Protein
Psychology
Public
Public Aff
Public Health
Public Relat
Purchasing
Quantum
Race
Radiation
Reading
Reasoning
Recall
Recreation
Reference
Region
Regression
Relativity
Religion
Renaissance
Reproduction
Research
Resources
Restaurant
Retardation
Revolution
Rhetoric
Rock
Romance
Rome
Rural
Russian
Sanitation
Sanskrit
Satire
Scandinavia
Science
Science Fict
Sculpture
Self
Semantics
Sense
Sex
Shakespeare
Slavery
Slavic Stu
Social
Social Class
Social Sci

Socialism
Socialization
Society
Sociology
Soils
Solar System
Sound
Soviet Union
Space
Spain
Speech
Spelling
Sport
State
Statistics
STPEC
Strata
Structures
Studying
Survey
Sweden
Swimming
Syntax
Synthesis
Systems
Taiwan
Taxonomy
Tea
Teaching
Technology
Test Taking
Theory
Therapy
Thermodynamics
Thesis
Thinking
Third World
Titration
Topology
Tourism
Toxin
Tradition
Tragedy
Translation
Transport
Tudor
Tutoring
Unemployment
Union
University
Urban
Vector
Vertebrate
Virus
Vision
Vitamin
Vocabulary
Voice
Wage
War
Waste Disposal
Water
Wave
Welfare
West
Wildlife
Woman
Work
World
Writing
Zoology

ANY OTHERS

EXHIBIT C: CASPER DICTIONARY LISTING

KEYWORDS	SYNONYMS	
Natural Scie		
	Naturalism	Synonym for Nature
	Naturalistic	Synonym for Nature
Nature		
Near East		
	Negro	Synonym for Afroamerican
	Neighborhood	Synonym for Community
Nerve		
	Nervous	Synonym for Nerve
	Neuron	Synonym for Nerve
Neuroscience		
New England		
	Newspaper	Synonym for Journalism
	Noise	Synonym for Sound
Note Taking		
Novel		
	Novelist	Synonym for Novel
	Nuclear	Synonym for Nucleus
	Nuclei	Synonym for Nucleus
Nucleus		
	Nurse	Synonym for Nursing
Nursing		
Nutrition		
	Nutritional	Synonym for Nutrition
Occupation		
Ocean		
	Oceanography	Synonym for Ocean
Old Age		
	Opera	Synonym for Music
Oppression		
	Optical	Synonym for Optics
Optics		
	Oration	Synonym for Speech
Organic		
Organization		
Ornithology		
	Pacifism	Synonym for Peace
	Pacifist	Synonym for Peace
Painting		
	Particle	Synonym for Atom
Pathology		

EXHIBIT D: KEYWORD FREQUENCY DISTRIBUTION

KEYWORD	FREQUENCY
Natural Scie	2
Nature	1
Near East	3
Nerve	0
Neuroscience	0
New England	2
Note Taking	1
Novel	3
Nucleus	1
Nursing	2
Nutrition	5
Occupation	14
Ocean	8
Old Age	3
Oppression	1
Optics	2
Organic	1
Organization	28
Ornithology	0
Painting	3
Pathology	2
Peace	1
People	12
Perception	8
Performance	10
Personality	5
Personnel	0
Persuasion	4
Pesticide	1
Petroleum	3
PH	0
Philosophy	12
Phonetics	3
Physical	0
Physical Edu	22
Physics	1
Physiology	2
Planning	13
Plato	0
Poetry	6
Poland	0
Police	0
Policy	3

401

```
PLEASE TYPE YOUR SELECTION CRITERIA AND PRESS "ENTER".


   KEY WORD 1: JOURNALISM_

   KEY WORD 2:

   KEY WORD 3:

   KEY WORD 4:

   KEY WORD 5:

   KEY WORD 6:

   STARTING BETWEEN    AND

   ON DAY

   DISTRIBUTION AREA



USE 24 HOUR TIME FOR STARTING HOUR. FOR EXAMPLE 09 IS 9:00 AM AND 21 IS 9:00 PM.
ONLY THE FIRST TWO LETTERS OF THE DAY ARE NECESSARY.
ONLY THE FIRST 12 LETTERS OF THE KEYWORDS ARE USED.
PRESS "CLEAR" TO STOP.
```

EXHIBIT E: INPUT TRANSACTION SCREEN

```
15 COURSES MEET YOUR NEEDS

DEPT   NO  SECT TITLE                  INSTRUCTOR         FORMAT     AREA SCHEDNO

JS     290C  1   MEDIA CRITICISM       WHITEHEAD R         LECTURE          441349
    MEETS MWF 11.15                                  03 CREDITS     FOR BOTH

JS     200   2   INTR NEWS & PRTING    FAULKNER F          LECTURE          440659
    MEETS MW 9.05-11.00                              03 CREDITS     FOR MAJORS

COMSTU 221   1   MEDIA PROGRAMMING     SHELBY M            LECTURE          162829
    MEETS MWF 3.35                                   03 CREDITS     FOR BOTH

JS     395A  1   SEM-ADVANCED PUB R    CLIFFORD A          SEMINAR          443921
    MEETS TUTH 4.00-5.15     JS 290P    REQUIRED 03 CREDITS     FOR MAJORS

COMSTU 121   1   INTRO TO MASS COMM    BRYANT J            LECTURE     D    162285
    MEETS TUTH 9.30-10.45                            03 CREDITS     FOR BOTH

JS     200   3   INTR NEWS & PRTING    *****CLOSED*****    LECTURE          440680
    MEETS MW 18.30-20.30                             03 CREDITS     FOR MAJORS


                                       TO SEE THE NEXT PAGE TYPE "N";
TO SEE YOUR CRITERIA AGAIN, TYPE "C" AND PRESS "ENTER". YOUR REPLY: _
```

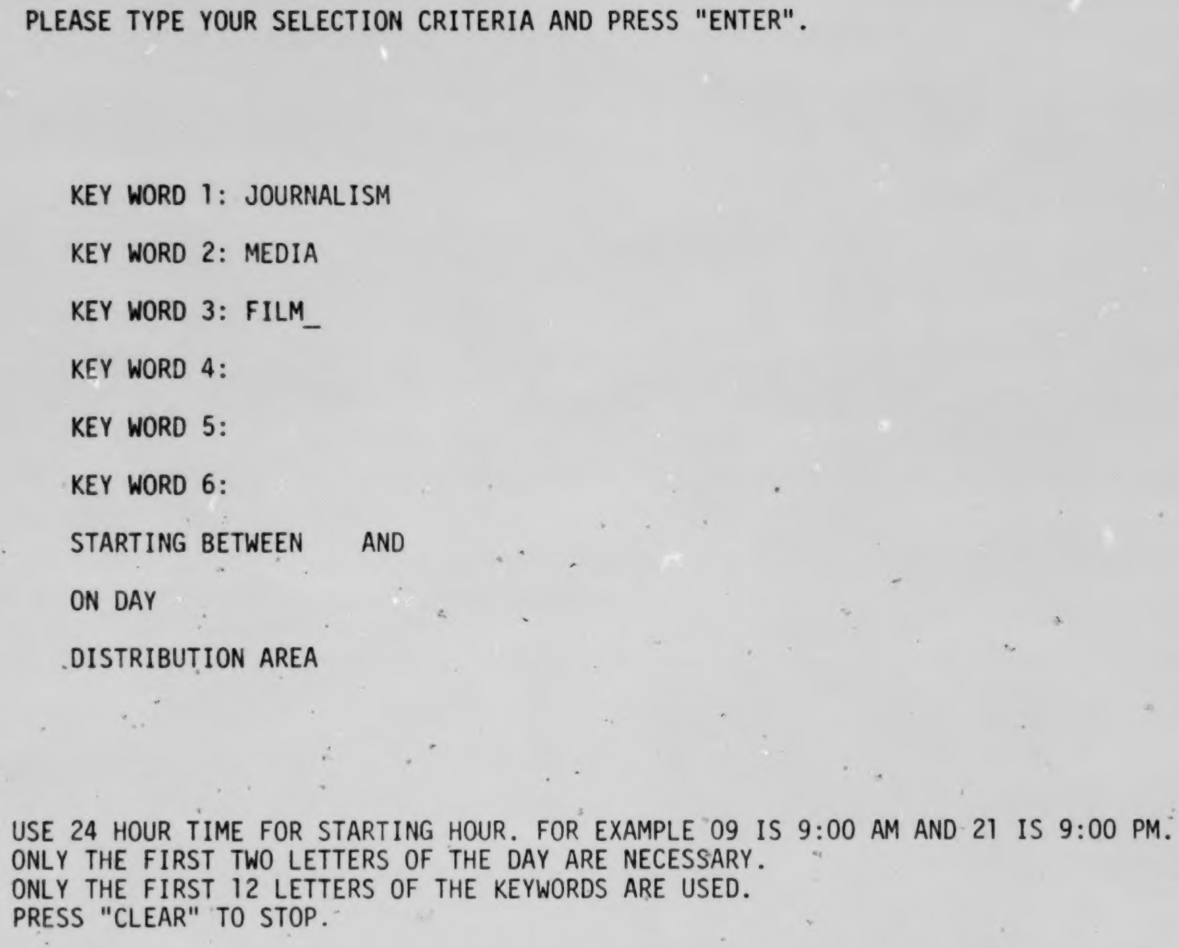
EXHIBIT FI: COURSE DATA OUTPUT SCREEN

```
 15 COURSES MEET YOUR NEEDS

DEPT   NO  SECT TITLE                  INSTRUCTOR         FORMAT     AREA SCHEDNO

JS      392A  1   SEM-MAG ART WRITIN   GRIMES S           SEMINAR         443712
     MEETS TUTH 1.00-2.15     JS 200&PER REQUIRED 03 CREDITS     FOR MAJORS

JS      225   1   INTERMED REPORTING   ZIFF H             LECTURE         441109
     MEETS MW 4.40-18.00      JS 200     REQUIRED 03 CREDITS     FOR MAJORS

JS      225   3   INTERMED REPORTING   *****CLOSED*****   LECTURE         441116
     MEETS TUTH 2.30-3.45     JS 200     REQUIRED 03 CREDITS     FOR MAJORS

JS      375   1   NEWS EDITING         GRIMES S           LECTURE         443298
     MEETS M 9.05-12.05       JS 200     REQUIRED 03 CREDITS     FOR MAJORS

JS      200   1   INTR NEWS PRTING     FILOSI-HUMPHREY P  LECTURE         440628
     MEETS MW 11.15-1.10                          03 CREDITS     FOR MAJORS

JS      375   2   NEWS EDITING         STAFF              LECTURE         443325
     MEETS TU 2.30-5.30       JS 200     REQUIRED 03 CREDITS     FOR MAJORS


TO SEE THE PREVIOUS PAGE TYPE "P"; TO SEE THE NEXT PAGE TYPE "N";
TO SEE YOUR CRITERIA AGAIN, TYPE "C" AND PRESS "ENTER". YOUR REPLY: _
```

EXHIBIT F2: COURSE DATA OUTPUT SCREEN

```
 15 COURSES MEET YOUR NEEDS

DEPT   NO  SECT TITLE                 INSTRUCTOR         FORMAT     AREA SCHEDNO


JS     298A  1   PRAC-JOURNLSM INTN   STAFF              IND. STUDY      442933
    MEETS BY ARRGT           PERMISSION REQUIRED VA CREDITS     FOR MAJORS

JS     225   2   INTERMED REPORTING   PINKHAM L          LECTURE         441130
    MEETS TUTH 1.00-2.15     JS 200     REQUIRED 03 CREDITS     FOR MAJORS

JS     396   1   INDEPENDENT STUDY    STAFF              IND. STUDY      444104
    MEETS BY ARRGT           PERMISSION REQUIRED VA CREDITS     FOR MAJORS




TO SEE THE PREVIOUS PAGE TYPE "P";
TO SEE YOUR CRITERIA AGAIN, TYPE "C" AND PRESS "ENTER". YOUR REPLY: _
```

EXHIBIT F3: COURSE DATA OUTPUT SCREEN



```
PLEASE TYPE YOUR SELECTION CRITERIA AND PRESS "ENTER".



   KEY WORD 1: JOURNALISM

   KEY WORD 2: MEDIA

   KEY WORD 3: FILM_

   KEY WORD 4:

   KEY WORD 5:

   KEY WORD 6:

   STARTING BETWEEN    AND

   ON DAY

   DISTRIBUTION AREA



USE 24 HOUR TIME FOR STARTING HOUR. FOR EXAMPLE 09 IS 9:00 AM AND 21 IS 9:00 PM.
ONLY THE FIRST TWO LETTERS OF THE DAY ARE NECESSARY.
ONLY THE FIRST 12 LETTERS OF THE KEYWORDS ARE USED.
PRESS "CLEAR" TO STOP.
```

EXHIBIT G: CROSS DISCIPLINE SEARCHING

```
 1 COURSES MEET YOUR NEEDS

DEPT   NO  SECT TITLE                  INSTRUCTOR         FORMAT     AREA SCHEDNO

COMSTU 340   1   HIST & DEV MOT PIC   STROMGREN          LECT/DISC        165797
     MEETS F 1.25-3.20                              03 CREDITS     FOR BOTH









TO SEE YOUR CRITERIA AGAIN, TYPE "C" AND PRESS "ENTER". YOUR REPLY: _
```

EXHIBIT H: CROSS DISCIPLINE SEARCHING

```
PLEASE TYPE YOUR SELECTION CRITERIA AND PRESS "ENTER".


  KEY WORD 1: FILM

  KEY WORD 2: LITERATURE

  KEY WORD 3: HISTORY

  KEY WORD 4: WOMEN_

  KEY WORD 5:

  KEY WORD 6:

  STARTING BETWEEN    AND

  ON DAY

  DISTRIBUTION AREA



USE 24 HOUR TIME FOR STARTING HOUR. FOR EXAMPLE 09 IS 9:00 AM AND 21 IS 9:00 PM.
ONLY THE FIRST TWO LETTERS OF THE DAY ARE NECESSARY.
ONLY THE FIRST 12 LETTERS OF THE KEYWORDS ARE USED.
PRESS "CLEAR" TO STOP.
```

EXHIBIT I: CROSS DISCIPLINE SEARCHING

```
  2 COURSES MEET YOUR NEEDS

DEPT   NO  SECT TITLE                 INSTRUCTOR         FORMAT     AREA SCHEDNO

COMSTU 340   1   HIST & DEV MOT PIC   STROMGREN          LECT/DISC       165797
     MEETS F 1.25-3.20                             03 CREDITS     FOR BOTH

ENGL   131   1   SOCIETY AND LIT      LEHENY             LECT/DISC  C    255676
     MEETS TUTH 9.30-10.45                         03 CREDITS     FOR BOTH






TO SEE YOUR CRITERIA AGAIN, TYPE "C" AND PRESS "ENTER". YOUR REPLY: _
```

EXHIBIT J: CROSS DISCIPLINE SEARCHING

```
PLEASE TYPE YOUR SELECTION CRITERIA AND PRESS "ENTER".


   KEY WORD 1: PSYCHOLOGY

   KEY WORD 2: SOCIOLOGY

   KEY WORD 3:

   KEY WORD 4:

   KEY WORD 5:

   KEY WORD 6:

   STARTING BETWEEN 09 AND 14

   ON DAY TU

   DISTRIBUTION AREA D



USE 24 HOUR TIME FOR STARTING HOUR. FOR EXAMPLE 09 IS 9:00 AM AND 21 IS 9:00 PM.
ONLY THE FIRST TWO LETTERS OF THE DAY ARE NECESSARY.
ONLY THE FIRST 12 LETTERS OF THE KEYWORDS ARE USED.
PRESS "CLEAR" TO STOP.
```

EXHIBIT K: SCHEDULING CRITERIA SEARCHING

```
 4 COURSES MEET YOUR NEEDS

DEPT   NO  SECT TITLE                  INSTRUCTOR         FORMAT    AREA SCHEDNO

SOCIOL 241   2   CRIMINOLOGY           DRIVER E             LECT/DISC  D    686771
     MEETS TUTH 1.00-2.15                            03 CREDITS      FOR BOTH

SOCIOL 109   1   POPULATION&ENVIRON    MEHTA S              LECT/DISC  D    685098
     MEETS TUTH 9.30-10.45                           03 CREDITS      FOR BOTH

SOCIOL 440   1   SOC OF AGING          CHEVAN A             LECT/DISC  D    690371
     MEETS TUTH 9.30-10.45                           03 CREDITS      FOR BOTH

SOCIOL 105   1   SELF,SOC & INTER      STAFF                LECT/DISC  D    684346
     MEETS TUTH 1.00-2.15                            03 CREDITS      FOR BOTH




TO SEE YOUR CRITERIA AGAIN, TYPE "C" AND PRESS "ENTER". YOUR REPLY: _
```

EXHIBIT L: SCHEDULING CRITERIA SEARCHING

```
MORE THAN 18 COURSES SATISFY YOUR CRITERIA.
PLEASE BE MORE SPECIFIC. TYPE IN MORE CRITERIA AND PRESS "ENTER".


   KEY WORD 1: LITERATURE

   KEY WORD 2: VOCABULARY

   KEY WORD 3:

   KEY WORD 4:

   KEY WORD 5:

   KEY WORD 6:

   STARTING BETWEEN 09 AND 14

   ON DAY _

   DISTRIBUTION AREA


USE 24 HOUR TIME FOR STARTING HOUR. FOR EXAMPLE 09 IS 9:00 AM AND 21 IS 9:00 PM.
ONLY THE FIRST TWO LETTERS OF THE DAY ARE NECESSARY.
ONLY THE FIRST 12 LETTERS OF THE KEYWORDS ARE USED.
PRESS "CLEAR" TO STOP.
```

EXHIBIT M: INTERACTIVE MESSAGING

```
I CAN'T INTERPRET WHAT YOU ENTERED.
PLEASE EITHER (1) CHANGE OR (2) ERASE (WITH THE SPACE BAR) THE INDICATED
  CRITERIA AND PRESS "ENTER".


   KEY WORD 1: LITERATURE

   KEY WORD 2: VOCABULARY

   KEY WORD 3: SCIENCS        ISN'T IN MY DICTIONARY

   KEY WORD 4: FRENCH REVOLTI ISN'T IN MY DICTIONARY

   KEY WORD 5: ON             ISN'T IN MY DICTIONARY

   KEY WORD 6:

   STARTING BETWEEN 8  AND 14 DOESN'T MAKE SENSE. 8 SHOULD BE 2 DIGITS.

   ON DAY MI                  DOESN'T MAKE SENSE. NO DAY BEGINS WITH MI.

   DISTRIBUTION AREA A        DOESN'T MAKE SENSE. THERE IS NO AREA A.



USE 24 HOUR TIME FOR STARTING HOUR. FOR EXAMPLE 09 IS 9:00 AM AND 21 IS 9:00 PM.
ONLY THE FIRST TWO LETTERS OF THE DAY ARE NECESSARY.
ONLY THE FIRST 12 LETTERS OF THE KEYWORDS ARE USED.
PRESS "CLEAR" TO STOP.
```

EXHIBIT N: INTERACTIVE MESSAGING

```
 I CAN'T INTERPRET WHAT YOU ENTERED.
 PLEASE EITHER (1) CHANGE OR (2) ERASE (WITH THE SPACE BAR) THE INDICATED
   CRITERIA AND PRESS "ENTER".


      KEY WORD 1: LITERATURE

      KEY WORD 2: VOCABULARY

      KEY WORD 3: SCIENCE

      KEY WORD 4: FRENCH REV     ISN'T IN MY DICTIONARY.

      KEY WORD 5:

      KEY WORD 6:

      STARTING BETWEEN 01 AND 24 DOESN'T MAKE SENSE. 01 IS TOO EARLY.

      ON DAY MO

      DISTRIBUTION AREA C



USE 24 HOUR TIME FOR STARTING HOUR. FOR EXAMPLE 09 IS 9:00 AM AND 21 IS 9:00 PM.
ONLY THE FIRST TWO LETTERS OF THE DAY ARE NECESSARY.
ONLY THE FIRST 12 LETTERS OF THE KEYWORDS ARE USED.
PRESS "CLEAR" TO STOP.
```

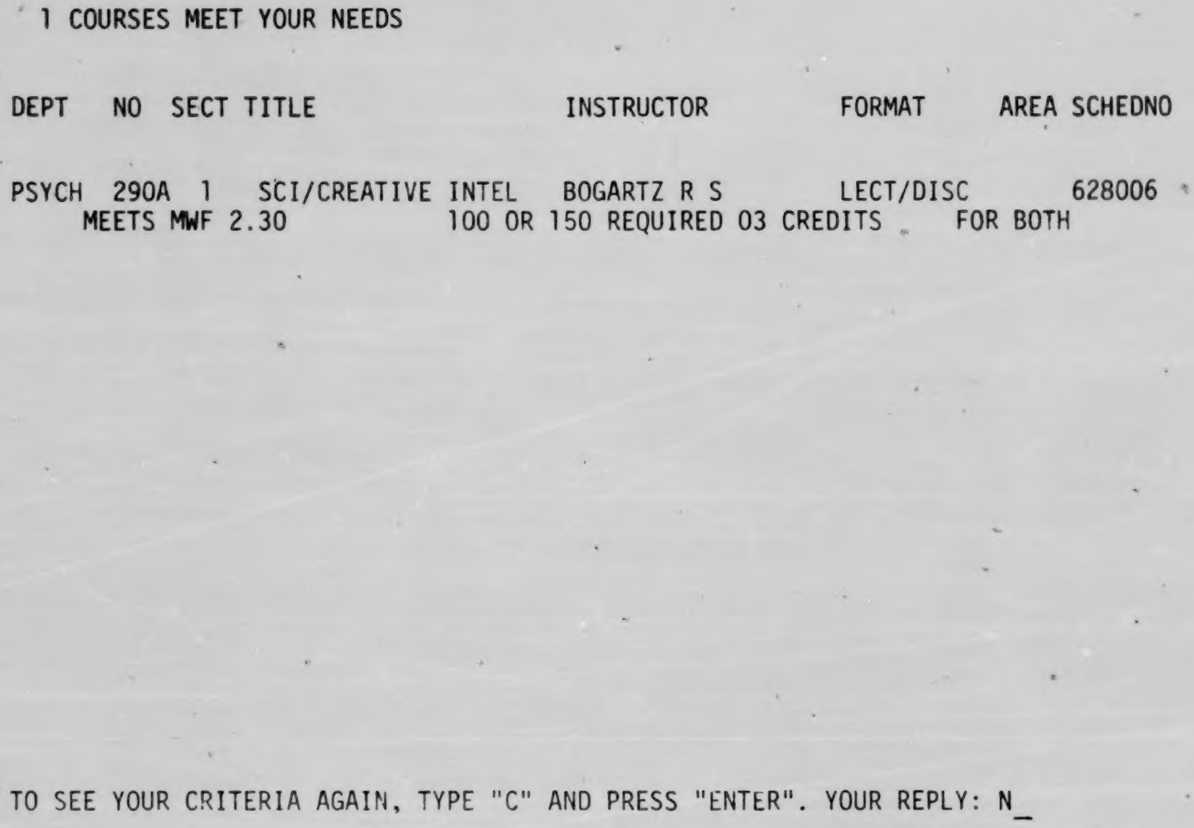
EXHIBIT O: INTERACTIVE MESSAGING

```
I CAN'T INTERPRET WHAT YOU ENTERED.
PLEASE EITHER (1) CHANGE OR (2) ERASE (WITH THE SPACE BAR) THE INDICATED
  CRITERIA AND PRESS "ENTER".


    KEY WORD 1: LITERATURE

    KEY WORD 2: VOCABULARY

    KEY WORD 3: SCIENCE

    KEY WORD 4:

    KEY WORD 5:

    KEY WORD 6:

    STARTING BETWEEN 08 AND 24 DOESN'T MAKE SENSE. 24 IS TOO LATE.
                            --
    ON DAY MO

    DISTRIBUTION AREA C



USE 24 HOUR TIME FOR STARTING HOUR. FOR EXAMPLE 09 IS 9:00 AM AND 21 IS 9:00 PM.
ONLY THE FIRST TWO LETTERS OF THE DAY ARE NECESSARY.
ONLY THE FIRST 12 LETTERS OF THE KEYWORDS ARE USED.
PRESS "CLEAR" TO STOP.
```

EXHIBIT P: INTERACTIVE MESSAGING

```
NO COURSES SATISFY YOUR CRITERIA.
ERASE (WITH THE SPACE BAR) SOME OF YOUR CRITERIA AND PRESS "ENTER".


    KEY WORD 1: LITERATURE

    KEY WORD 2: VOCABULARY

    KEY WORD 3: SCIENCE

    KEY WORD 4:

    KEY WORD 5:

    KEY WORD 6:

    STARTING BETWEEN    AND

    ON DAY MO

    DISTRIBUTION AREA C



USE 24 HOUR TIME FOR STARTING HOUR. FOR EXAMPLE 09 IS 9:00 AM AND 21 IS 9:00 PM.
ONLY THE FIRST TWO LETTERS OF THE DAY ARE NECESSARY.
ONLY THE FIRST 12 LETTERS OF THE KEYWORDS ARE USED.
PRESS "CLEAR" TO STOP.
```

EXHIBIT Q: INTERACTIVE MESSAGING



```
1 COURSES MEET YOUR NEEDS

DEPT   NO  SECT TITLE                   INSTRUCTOR        FORMAT     AREA SCHEDNO

PSYCH  290A  1   SCI/CREATIVE INTEL     BOGARTZ R S       LECT/DISC       628006
     MEETS MWF 2.30           100 OR 150 REQUIRED 03 CREDITS      FOR BOTH










TO SEE YOUR CRITERIA AGAIN, TYPE "C" AND PRESS "ENTER". YOUR REPLY: N_
```

EXHIBIT R: INTERACTIVE MESSAGING

EXHIBIT S:

CASPER DICTIONARY MAINTENANCE

Function codes are D1 - Add or redefine a synonym
D2 - Add a key word
D3 - Delete a key word or synonym

FUNCTION 1	KEY WORD OR SYNONYM 3	DEFINITION (D1 ONLY) 15
D3	WOMAN	
D2	WOMEN	
D1	WOMENS STUDI	WOMEN
D3	SWEDEN	
D3	SALTATION	
D1	NOISE	SOUND
D1	ROMAN	CLASSICAL
D2	TV	
D1	WOMAN	WOMEN
D1	WORK	OCCUPATION
D2	INTERPOLATIO	
D3	ACID	
D2	BIBLE	
D3	BIOPHYSICS	
D2	CAMBRIAN	
D1	FLORISTICS	BOTANY

APPENDIX I: A TRAINING GUIDE

USING CASPER

by
Michael Lamson
Management Systems Office

ABOUT CASPER

CASPER stands for Computer Assistance for Students Preparing to Elect courses for Registration. CASPER is a computer program that analyzes a student's description of a course and finds all the courses that match the description. The description may include up to six subject matter key words, the hour at which the course meets, the first day of the week on which it meets, and the distribution area it satisfies. These elements of the description are called selection criteria; CASPER will find courses that match any or all of them.

SYSTEM AVAILABLE

CASPER is a teleprocessing program--a program run from a computer terminal connected to a computer by telephone lines. CASPER and many other such programs run under the control of a master program called a teleprocessing monitor. CICS is the name of the University's teleprocessing monitor; CICS must be working ("up") before CASPER can be run. When CICS is "up", the green light on the terminal marked SYSTEM AVAILABLE is lit. CASPER uses two data files, called the CASPER file and the log file; CICS must have these files available ("open") before CASPER can be run. Occasionally CICS is "down" or one of the files is "closed"--the significance of either is that CASPER cannot be used until the condition is corrected.

USING THE TERMINAL

CURSOR

FIELD

CASPER is used with an IBM 3270 terminal, which resembles a television screen with a typewriter keyboard attached. As one types on the keyboard, letters appear on the screen above a moving horizontal line called the cursor. Unlike a typewriter, the terminal allows one to type only on certain areas of the screen called fields.

ENTER
CLEAR
FIELD SKIP (→| AND |←)

In addition to the usual typewriter keys, the 3270 keyboard contains keys marked with words and symbols. The ENTER key sends a screen of information along the telephone line to CASPER to be analyzed. Until the ENTER key is struck, CASPER just waits, no matter what is typed on the screen. The CLEAR key ends the dialogue with CASPER. When the CLEAR key is struck, the screen is erased and CASPER forgets the selection criteria it was using and any courses it had found. At the left and the right of the top row of letters are the field skip keys, left and right pointing horizontal arrows colliding with vertical lines. The forward (right pointing) field skip moves the cursor on to the next field on the screen; the backward (left pointing) field skip moves the cursor back to the last field on the screen.

INPUT INHIBITED
RESET

When the ENTER key is struck, the INPUT INHIBITED light comes on. This means that the keyboard is locked--nothing can be typed on the screen--until CASPER responds. Certain other keys can lock the keyboard; if the keyboard is locked accidentally, the RESET key may be used to unlock it.

USING CASPER

To begin using CASPER one merely types "CASPER" on the terminal keyboard and presses the ENTER key. CASPER responds with an array of messages (called a display) that show where selection criteria--key words, starting hours, starting day, and distribution area--are to be typed. If the word or code typed fills the field, the cursor jumps to the next field. If the word or code does not fill the fields, one uses the forward field skip (to the left of the Q key). This key is also used to skip over fields; for example, it's not likely that any course will match six key words. To go back to a field that was typed wrong, one uses the reverse field skip (to the right of the exclamation point). One can correct a mistake either by typing over it or by repeatedly striking the space bar.

The words in CASPER's dictionary have been truncated to twelve letters to save space, as one can see when CASPER re-displays them. If one types a key word longer than fourteen letters, the cursor jumps to the next line. One should not continue typing--the remainder will be interpreted as another key word. Only the hour at which a course starts may be typed--courses beginning at five past, ten past, and so on are all found by specifying the hour. Two starting hours are necessary, or none, and they must be in twenty-four hour time. Hours before twelve must have a leading zero. Only the first two letters of the starting day can be typed--any more will carry into the distribution area (core) field. The meaning of the distribution area codes can be found in the current catalog.

When CASPER finds courses that match the selection criteria, it displays them six at a time on the screen. Two lines are devoted to each course. The first line contains the department, course number, section number, title, instructor, course format, distribution area, and schedule number, under the headings at the top. The second line tells the meeting time, the prerequisite if any, the number of credits, and whether the course is for majors, non-majors, or both groups. At the bottom of the screen CASPER asks for instructions. Six courses make up a page: if CASPER found more than six it may ask whether to display the next page, or the previous page. In any case one can always go back to look at the selection criteria again.

PAGE

CASPER can only remember eighteen courses--three pages--at once. If more than eighteen courses match the description, it asks that the selection criteria be made more specific; usually this amounts to filling in more fields.

If CASPER couldn't find any courses that matched the description, it asks that some criteria be erased. If the description consists of a single key word, the game is up.

CASPER's intelligence is limited. For example, it can't detect misspelled words or alternate methods of starting time. When it comes to something it doesn't understand, it sends an error message and waits until it is corrected.

CASPER ERRORS

These are listed alphabetically. Any error not found in this list should be copied and reported to the Data Processing Center. One or more X's represent text that varies.

FILE XXXXXX IS NOT OPEN

Copy this message and report it to the Data Processing Center.

I CAN'T INTERPRET WHAT YOU ENTERED

Other error messages appear next to the fields in error.

I CAN'T INTERPRET YOUR REPLY

Only the letters given in the message at the bottom of the course display may be typed at the lower right. Hitting the space bar before typing the letter causes this error.

ISN'T IN MY DICTIONARY

The key word before this message isn't in the dictionary. This can be because it is misspelled, it begins with one or more spaces, or a piece of the previous key word entered in this field is still on the screen.

MORE THAN 18 COURSES SATISFY YOUR CRITERIA

CASPER can only remember 18 courses at once. It is necessary to make the selection criteria more restrictive: add more key words, add starting hours or reduce their range, add a starting day, or add a distribution area.

NO COURSES SATISFY YOUR CRITERIA

No course matches all of the criteria. This may be because some fields weren't erased after the last search. If more than one field is filled, eliminate the least important and try again.

NO DAY BEGINS WITH XX

The starting day is not one of: MO, TU, WE, TH, FR, SA. (No courses begin on Sunday.)

THE DAY HAS ONLY 24 HOURS

One of the starting hours is greater than 24.

THERE IS NO AREA X

Consult the course catalog for a list of the distribution area (core) codes.

The following messages begin with numbers:

a IS LATER THAN b

Because twenty-four hour time is used, the first starting hour must always be less than the second.

a IS TOO EARLY

To save time, CASPER doesn't bother looking for courses beginning before 6:00 a.m.

440

a IS TOO LATE

To save time, CASPER doesn't bother looking for courses beginning after 9:00 p.m.

a SHOULD BE TWO DIGITS

Starting hours before noon must be expressed as 07, 08, 09, etc.

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AICPA AUDIT GUIDE REPORTING* MADE EASY

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*American Institute of Certified Public Accountants (AICPA) Audit Guide Standards for Year-End External Reporting for Post Secondary Education

ABSTRACT

From the largest base of colleges and universities using a single Financial Accounting System (more than 80 users), three representative institutions participated in a panel discussion regarding the use and benefits of the IAI-AICPA Audit Guide Reporting Module.

A brief introductory description of the module was given showing how external user-maintained tables, dictionary-defined data elements, and execute-time parameters permit users to develop desired outputs.

The panel described how this annual report can be produced on a routine basis to provide important management information and permit early corrective action of problem situations.

Background

Representatives from three of the more than eighty institutions using the IAI Financial Accounting System participated in a panel discussion regarding the benefits to be gained from an easy-to-use computer generation, on a monthly basis, of the three formal financial statements defined by the AICPA Audit Guide.[1]

These three statements are as follows:

Exhibit A	Balance Sheet
Exhibit B	Statement of Changes in Fund Balances
Exhibit C	Statement of Current Funds Revenues, Expenditures, and Other Changes

Sample formats for these exhibits follow (see Figures 1, 2, and 3).

The need for financial reporting is very evident in large, complex institutions, but this need exists in all institutions regardless of size. The multitude of funding sources and the fact that there are no particular fiscal year-end standards for these sources intensifies the demand on accounting. Furthermore, these demands are not only for meeting external requirements but for management reporting for the institution as a whole. Further yet, it is highly desirable to be able to meet the management reporting needs of major components of the institution, such as divisions, individual campuses, medical centers, colleges, etc.

The end of any month may coincide with the end of an accounting year for any particular activity. Many institutions in New York, for example, normally have a fiscal year which ends on June 30. But they also have a State year-end on March 31, Federal year-end considerations on September 30, and possibly hospital reporting on a calendar year basis. For those with federally supported research, any month can be a year-end for a particular project.

In response to this, some institutions have established operational procedures for each month-end which encompass the traditional year-end functions and reports as well.

Financial reporting is certainly more extensive than the AICPA Audit Guide formats for traditional year-end statements. However, these reports are critical and have been used as a vehicle to demonstrate the ability to produce consolidated statements easily. The computerized modules used to produce these reports are an integral part of the IAI Financial Accounting System. It is not the intent of this paper to explain that system since a detailed description is available directly from IAI.

Overview

Traditionally, institutions have produced the three exhibits only at the end of the fiscal year. In spite of the difficulty to produce these reports and the time and effort required of the accounting staff, the demand for this information by institutional management and external auditors makes these reports mandatory.

The creation of these reports required laborious worksheets and complex decisions regarding classification and proper postings. This meant that at least three weeks and possibly several months were required to accomplish the task of producing the final reports.

The use of computerized information management systems has now made this task easy. The rules for classification and postings can be stored in the computer and the decisions and paperwork accomplished automatically.

In addition, the formats of the formal reports can be stored in the computer in a "directory". With these aids, a formal report and detailed audit trails can be produced to facilitate the analysis and verification which is still required by the accounting staff.

With a preliminary computer run at month-end, a day or two for analysis and adjustments, and then a final run on the computer, these reports can be produced a few days after the monthly closing with relatively little effort. It now becomes possible to perform this reporting routinely on a monthly basis and for entities other than the entire institution. Thus, the Audit Guide report formats become a useful tool for management of the institution.

Approach

Figure 4 depicts the computer system components incorporated in the AICPA Reporting Module. A brief description of each component follows:

A. Data Base

This is a collection of dollar data stored with the account number as the key. The structure of the account number is of no particular importance except that precise definitions exist to identify revenues, expenditures, assets, liabilities, fund balances, fund additions, and fund deductions. The data base also contains descriptive data elements (or account attributes) along with a mechanism to relate specific values to each account. (Figure 5 lists typical attributes which would be associated with each account. Of course, the system is open-ended to permit the user to add additional attributes when required.

B. Dictionary

This computer file contains definitions of all data elements in the data base (but not the specific values for an account). The Dictionary defines data locations, format characteristics, and valid values or ranges. It is used for documentation, data validation, file maintenance control, and reporting control. A sample report from the Dictionary is shown in Figure 6.

C. Report Control File

This file permits the user to store and maintain a variety of report specifications which would normally be a part of the computer software. Depending on the report, the user has complete latitude in definition of lines (text and dollar data) and columns. An example of the report definition is shown in Figures 7 and 10.

D. Parameter Statement

The user has additional latitude which may be exercised at the time the Reporting Module is run on the computer. As an example, the AICPA Audit Guide Revenue and Expense Statement may be generated for the whole institution or only for a single campus. This type of decision can be made just prior to running the system and simply coded on the parameter statement.

E. Computer Programs

Computer programs exist to produce each of the three AICPA Audit Guide exhibits. There are several options for each and a good deal of flexibility derived from the use of the Dictionary and Report Control File. The summary report (financial statement exhibit) may be produced with or without a detailed audit list.

F. Reports

Examples of several reports are shown. Figures 7, 8, and 9 show a sequence of a university Statement of Changes in Fund Balances.

Similarly, Figures 10, 11, and 12 are examples from a university for the Statement of Revenues, Expenditures and Other Changes.

Each institution produces these reports monthly as a routine part of their month-end operating procedure. With the same computer software, the institutions are producing variations to the basic reports to serve other needs. A few examples of this are discussed subsequently.

Benefits

The benefits noted by each panel member are summarized below.

Many institutions are mandating greater management responsibility at lower levels (e.g., Deans, Division Directors). These reports produced on a timely basis are very supportive of this need. The reports can easily be produced by division or college, by campus, and, in some cases, by department.

Individual Vice Presidents and internal auditors receive these statements routinely. The statements are obviously a significant aid to the external auditors also.

Managers of auxiliary enterprises (housing, board plan, etc.) had never been able to obtain consolidated statements. Using reports such as Figures 13 and 14, they can now detect deficits early enabling rate adjustments to avoid or minimize year-end losses.

The reports can also serve as an effective operational tool. Input data coding errors have been detected through the audit lists because certain revenue and expense totals did not match up. Similar problems were found with gift receipt postings in another example where restricted and unrestricted gifts were not properly segregated.

The AICPA Audit Guide formats for external reporting were changed in 1974 and are likely to change again soon. Not only will it be necessary to shift to the new definition, but it will also be necessary to document the transition to show "reporting consistency". The techniques employed in this module enable the user, without reprogramming the computer, to alter attributes and report control definitions and thus modify the content and format of the reports. Both the old and new formats can be produced for comparative analysis. Of equal importance, the transition will be automatically documented through the audit detail report.

With minor modifications to the computer software, the AICPA Reporting Module can produce a similar set of reports using JAG (Joint Accounting Group) classifications. These reports can be very useful for comparative analysis.

As managers become better acquainted with the capabilities of the module, they will want the financial statement data compared to budget information and possibly to last year or next year budget data. For some, encumbrance data will be important. Because of the design, such reports can be produced with minimal software modifications.

Summary

The AICPA Audit Guide Reporting Module of the Financial Accounting System is an excellent example of the effective use of information systems in the three institutions represented. Through the use of flexible system design, the mandatory requirement of meeting external financial statement reporting was accomplished. At the same time, a powerful management tool was provided for routine use by middle and upper management at the institutions.

Note: Mr. Cocklin was unfortunately unable to attend the CAUSE National Conference due to illness. He was represented on the panel by Mr. James Martin, Manager--Management Systems at the University of Colorado, Boulder, Colorado.

Reference

[1] Committee on College and University Accounting and Auditing, Audits of Colleges and Universities, (New York: American Institute of Certified Public Accountants, Inc., 1973).

FIGURE 1

```
COMPUTER DATE 04/05/77                 INFORMATION ASSOCIATES ACCOUNTING SYSTEM REPORT                        REPORT PAGE    1
   TIME OF DAY 11:14:38                                                                                       USER ID XX.I
PGM=AM05I                                    BALANCE SHEET AS OF 03/31/77

                                         CURRENT YEAR        PRIOR YEAR           VARIANCE

CURRENT FUNDS:
  UNRESTRICTED:
    ASSETS:
      CASH                                 210,000.00        110,000.00         100,000.00
        INVESTMENTS                        450,000.00        360,000.00          90,000.00
        ACCOUNTS RECEIVABLE                228,000.00        175,000.00          53,000.00
        INVENTORIES                         90,000.00         80,000.00          10,000.00
        PREPAID EXPENSES & DEFERRED CHGRS   28,000.00         20,000.00           8,000.00

          TOTAL UNRESTRICTED ASSETS      1,006,000.00        745,000.00         261,000.00

    LIABILITIES & FUND BALANCE
      ACCOUNTS PAYABLE                     125,000.00        100,000.00          25,000.00
      ACCRUED LIABILITIES                   20,000.00         15,000.00           5,000.00
      STUDENT DEPOSITS                      30,000.00         35,000.00          (5,000.00)
      DEFERRED REVENUES                    158,000.00        120,000.00           8,000.00
      DUE TO OTHER FUNDS                    30,000.00         20,000.00          10,000.00
      FUND BALANCE                         643,000.00        445,000.00         198,000.00
        TOTAL UNRESTRICTED
            LIABILITIES & FUND BALANCE   1,006,000.00        745,000.00         261,000.00

  RESTRICTED:
    ASSETS:
      CASH                                 145,000.00        101,000.00          44,000.00
      INVESTMENTS                          175,000.00        165,000.00          10,000.00
      ACCOUNTS RECEIVABLE                   68,000.00        160,000.00         (92,000.00)
      UNBILLED CHARGES                      72,000.00              0.00          72,000.00

        TOTAL RESTRICTED ASSETS            460,000.00        426,000.00          34,000.00

    LIABILITIES & FUND BALANCE
      ACCOUNTS PAYABLE                      14,000.00          5,000.00           9,000.00
      FUND BALANCE                         446,000.00        421,000.00          25,000.00
        TOTAL RESTRICTED
            LIABILITIES & FUND BALANCE     460,000.00        426,000.00          34,000.00

TOTAL CURRENT FUNDS ASSETS               1,466,000.00      1,171,000.00         295,000.00
TOTAL CURRENT FUNDS LIABILITIES &
                      FUND BALANCE       1,466,000.00      1,171,000.00         295,000.00

LOAN FUNDS:
  ASSETS:
      .
      .
      .
      TOTAL ASSETS                         683,000.00        502,000.00         181,000.00

  LIABILITIES & FUND BALANCE:
      .
      .
      .
      TOTAL LIABILITIES & FUND BALANCE     683,000.00        502,000.00         181,000.00
```

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EXHIBIT A

FIGURE 1 (continued)

EXHIBIT A

```
COMPUTER DATE 04/05/77                 INFORMATION ASSOCIATES ACCOUNTING SYSTEM REPORT                      REPORT PAGE    2
   TIME OF DAY 11:14:35                                                                                      USER ID XX.1
PGM=AM053                                    BALANCE SHEET AS OF 03/31/77

                                       CURRENT YEAR        PRIOR YEAR        VARIANCE

ENDOWMENT & SIMILAR FUNDS:
  ASSETS:
     .
     .
     .
     TOTAL ASSETS                    . 14,000,000.00     11,901,000.00     2,099,000.00

  LIABILITIES AND FUND BALANCE:
     .
     .
     .
     TOTAL LIABILITIES & FUND BALANCE  14,000,000.00     11,901,000.00     2,099,000.00

ANNUITY & LIFE INCOME FUNDS:
  ANNUITY:
     .
     .
  LIFE INCOME:
     .
     .
PLANT FUNDS:
  UNEXPENDED:
     .
     .
  RENEWAL & REPLACEMENT:
     .
     .
  RETIREMENT OF INDEBTEDNESS:
     .
     .
  INVESTMENT IN PLANT:
     .
     .
AGENCY FUNDS:
  ASSETS:
    CASH                                   50,000.00         70,000.00       (20,000.00)
    INVESTMENTS                            60,000.00         20,000.00        40,000.00

      TOTAL ASSETS                        110,000.00         90,000.00        20,000.00

  LIABILITIES:
    DEPOSITS HELD IN CUSTODY FOR OTHERS   220,000.00         90,000.00        20,000.00

      TOTAL LIABILITIES                   110,000.00         90,000.00        20,000.00
```

EXHIBIT B

```
COMPUTER DATE 12/04/76                      INFORMATION ASSOCIATES ACCOUNTING SYSTEM REPORT                          REPORT PAGE    1
  TIME OF DAY 02316:44                                                                                                 USER ID XX.1
PGM=AM055                         STATEMENT OF CURRENT FUNDS REVENUES, EXPENDITURES, AND OTHER CHANGES
                                                  FOR THE  5 MONTHS ENDED 11/76

                                         - - - - - - - - - - - - - -CURRENT YEAR- - - - - - - - - - - - -            PRIOR
                                            UNRESTRICTED             RESTRICTED              TOTAL                  YEAR TOTAL

REVENUES:
  EDUCATIONAL AND GENERAL:
    STUDENT TUITION AND FEES                3,120,000.00                                 3,120,000.00            2,760,000.00
    GOVERNMENTAL APPROPRIATIONS             1,560,000.00                                 1,560,000.00            1,560,000.00
    GOVERNMENTAL GRANTS AND CONTRACTS          42,000.00             510,000.00            552,000.00              614,000.00
    GIFTS AND PRIVATE GRANTS                1,020,000.00             456,000.00          1,476,000.00            1,428,000.00
    ENDOWMENT INCOME                          390,000.00             250,800.00            640,800.00              700,000.00
    SALES AND SERVICES OF EDUCATIONAL
          DEPARTMENTS                         228,000.00                                   228,000.00              234,000.00
    ORGANIZED ACTIVITIES RELATED TO
          EDUCATIONAL DEPARTMENTS
    OTHER SOURCES (IF ANY)
        TOTAL EDUCATIONAL AND GENERAL       6,360,000.00           1,216,800.00          7,576,800.00            7,296,000.00
  AUXILIARY ENTERPRISES                     2,640,000.00                                 2,640,000.00            2,620,000.00
  EXPIRED TERM ENDOWMENT                       48,000.00                                    48,000.00
        TOTAL REVENUES                      9,048,000.00           1,216,800.00         10,264,800.00            9,916,000.00

EXPENDITURES AND MANDATORY TRANSFERS:
  EDUCATIONAL AND GENERAL:
    INSTRUCTION AND DEPARTMENTAL RESEARCH   3,300,000.00                                 3,300,000.00            3,100,000.00
    ORGANIZED ACTIVITIES RELATED TO
          EDUCATIONAL DEPARTMENTS
    SPONSORED RESEARCH                        372,000.00           1,106,800.00          1,478,800.00            1,700,000.00
    OTHER SEPARATELY BUDGETED RESEARCH
    OTHER SPONSORED PROGRAMS
    EXTENSION AND PUBLIC SERVICE              156,000.00                                   156,000.00              150,000.00
    LIBRARIES                                 380,000.00                                   380,000.00              340,000.00
    STUDENT SERVICES                          240,000.00                                   240,000.00              234,000.00
    OPERATION AND MAINTENANCE OF PLANT        264,000.00                                   264,000.00              240,000.00
    GENERAL ADMINISTRATION
    GENERAL INSTITUTIONAL EXPENSE             460,000.00                                   460,000.00              464,000.00
    STUDENT AID                               118,000.00             110,000.00            228,000.00              216,000.00
        EDUCATIONAL AND GENERAL
              EXPENDITURES                  5,290,000.00           1,216,800.00          6,506,800.00            6,444,000.00

    MANDATORY TRANSFERS FOR:
      PRINCIPAL AND INTEREST                  108,000.00                                   108,000.00               60,000.00
      RENEWALS AND REPLACEMENTS               110,000.00                                   110,000.00               96,000.00
      LOAN FUND MATCHING GRANT                  2,400.00                                     2,400.00            6,660,000.00
        TOTAL EDUCATIONAL AND GENERAL       5,510,400.00           1,216,800.00          6,727,200.00

  AUXILIARY ENTERPRISES:
    EXPENDITURES                            2,196,000.00                                 2,196,000.00          . 2,276,000900
    MANDATORY TRANSFERS FOR:
      PRINCIPAL AND INTEREST                  300,000.00                                   300,000.00              100,000.00
      RENEWALS AND REPLACEMENTS                84,000.00                                    84,000.00               84,000.00
      TOTAL AUXILIARY ENTERPRISES           2,580,000.00                                 2,580,000.00            2,460,000.00
        TOTAL EXPENDITURES AND MANDATORY
              TRANSFERS                     8,090,400.00           1,216,800.00          9,307,200.00            9,060,000.00

OTHER TRANSFERS AND ADDITIONS/(DEDUCTNS)
  EXCESS OF RESTRICTED RECEIPTS OVER
              TRANSFERS TO REVENUES                                   54,000.00             54,000.00               48,000.00
  REFUNDED TO GRANTORS                                           (    24,000.00)      (     24,000.00)
  UNRESTRICTED GIFTS ALLOCATED TO OTHER
      FUNDS                            (      780,000.00)                             (    780,000.00)     (      712,000.00)
  PORTION OF QUASI-ENDOWMENT GAINS
      APPROPRIATED                             48,000.00                                    48,000.00

        NET INCREASE IN FUND BALANCES         225,600.00              30,000.00            255,600.00              192,000.00
```

FIGURE 2

EXHIBIT B

```
COMPUTER DATE 04/01/77                 INFORMATION ASSOCIATES ACCOUNTING SYSTEM REPORT                                          REPORT PAGE    2
   TIME OF DAY 11:14:35                                                                                                         USER ID XX.1
PGM=AM054                                   STATEMENT OF CHANGES IN FUND BALANCES
                                                        AS OF 03/31/77
                                          UNEXPENDED         RENEWAL AND     RETIREMENT OF        INVESTMENT
                                         PLANT FUNDS         REPLACEMENT     INDEBTEDNESS          IN PLANT
REVENUE AND OTHER ADDITIONS:
  EDUCATION AND GENERAL
  AUXILIARY ENTERPRISES
  EXPIRED TERM ENDOWMENT
  EXPIRED TERM ENDOWMENT-RESTRICTED       50,000.00
  GIFTS AND BEQUESTS                     115,000.00                          65,000.00           15,000.00
  GRANTS AND CONTRACTS
  GOVERNMENT APPROPRIATIONS               50,000.00
  INVESTMENT INCOME                        5,000.00           5,000.00        5,000.00
  REALIZED GAINS ON INVESTMENTS-UNREST
  REALIZED GAINS ON INVESTMENTS-REST'D    10,000.00           5,000.00        5,000.00
  INTEREST ON LOANS RECEIVABLE
  U.S. GOVERNMENT ADVANCES
  EXPENDED FOR PLANT FACILITIES                                                                1,550,000.00
  RETIREMENT OF INDEBTEDNESS                                                                     220,000.00
  ACCRUED INTEREST ON SALE OF BONDS                                           3,000.00
  MATURED ANNUITY & LIFE INCOME FUNDS
           RESTRICTED TO ENDOWMENT

   TOTAL REVENUES AND OTHER ADDITIONS    230,000.00          10,000.00       78,000.00         1,785,000.00

EXPENDITURES AND OTHER DEDUCTIONS:
  EDUCATIONAL AND GENERAL
  AUXILIARY ENTERPRIZES
  INDIRECT COSTS RECOVERED
  REFUNDED TO GRANTORS
  LOAN CANCELLATIONS AND WRITE-OFFS
  ADMINISTRATION AND COLLECTION COSTS                                         1,000.00
  ADJUSTMENT OF ACTUARIAL LIABILITY FOR
           ANNUITIES PAYABLE
  EXPENDED FOR PLANT FACILITIES        1,200,000.00         300,000.00
  RETIREMENT OF INDEBTEDNESS                                                220,000.00
  INTEREST ON INDEBTEDNESS                                                  190,000.00
  DISPOSAL OF PLANT FACILITIES                                                                   115,000.00
  EXPIRED TERM ENDOWMENTS
  MATURED ANNUITY AND LIFE INCOME FUNDS
           RESTRICTED TO ENDOWMENT

   TOTAL EXPENDITURES AND OTHER DEDUCTNS 1,200,000.00       300,000.00      411,000.00           115,000.00

TRANSFERS AMONG FUNDS-ADDITIONS/(DEDUCT)
  MANDATORY
    PRINCIPAL AND INTEREST                                                  340,000.00
    RENEWALS AND REPLACEMENTS                               170,000.00
    LOAN FUND MATCHING GRANT
  UNRESTRICTED GIFTS ALLOCATED            50,000.00
  PORTION OF UNRESTRICTED QUASI-ENDOWMT
    FUNDS INVESTMENT GAINS APPPROPRIATED

      TOTAL TRANSFERS                     50,000.00         170,000.00      340,000.00

NET INCREASE/(DECREASE) FOR THE YEAR    (920,000.00)       (120,000.00)       7,000.00         1,670,000.00
FUND BALANCE AT BEGINNING OF YEAR      2,120,000.00         380,000.00      293,000.00        36,540,000.00
FUND BALANCE AT END OF YEAR            1,200,000.00         260,000.00      300,000.00        38,210,000.00
```

FIGURE 2 (continued)

FIGURE 3

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COMPUTER DATE 04/06/77                     INFORMATION ASSOCIATES ACCOUNTING SYSTEM REPORT                      REPORT PAGE    1
   TIME OF DAY 11:14:35                                                                                          USER ID XX.1
PGM=AM054                                    STATEMENT OF CHANGES IN FUND BALANCES
                                                       AS OF 03/31/77

                                              CURRENT FUNDS                            LOAN      ENDOWMENT AND     ANNUITY AND
                                         UNRESTRICTED         RESTRICTED              FUNDS     SIMILAR FUNDS  LIFE INCOME FUNDS
REVENUE AND OTHER ADDITIONS:
  EDUCATION AND GENERAL                  5,300,000.00
  AUXILIARY ENTERPRISES                  2,200,000.00
  EXPIRED TERM ENDOWMENT                    40,000.00
  EXPIRED TERM ENDOWMENT-RESTRICTED
  GIFTS AND BEQUESTS                                         370,000.00          100,000.00      1,500,000.00       800,000.00
  GRANTS AND CONTRACTS                                       500,000.00
  GOVERNMENT APPROPRIATIONS
  INVESTMENT INCOME                                          224,000.00           12,000.00         10,000.00
  REALIZED GAINS ON INVESTMENTS-UNREST                                                             109,000.00
  REALIZED GAINS ON INVESTMENTS-REST'D                                             4,000.00         50,000.00
  INTEREST ON LOANS RECEIVABLE                                                     7,000.00
  U.S. GOVERNMENT ADVANCES                                                        18,000.00
  EXPENDED FOR PLANT FACILITIES
  RETIREMENT OF INDEBTEDNESS
  ACCRUED INTEREST ON SALE OF BONDS
  MATURED ANNUITY & LIFE INCOME FUNDS
            RESTRICTED TO ENDOWMENT                                                                 10,000.00

   TOTAL REVENUES AND OTHER ADDITIONS    7,540,000.00      1,094,000.00          141,000.00      1,679,000.00       800,000.00

EXPENDITURES AND OTHER DEDUCTIONS:
  EDUCATIONA AND GENERAL                 4,400,000.00      1,014,000.00
  AUXILIARY ENTERPRIZES                  1,830,000.00
  INDIRECT COSTS RECOVERED                                    35,000.00
  REFUNDED TO GRANTORS                                        20,000.00           10,000.00
  LOAN CANCELLATIONS AND WRITE-OFFS                                                1,000.00
  ADMINISTRATION AND COLLECTION COSTS                                              1,000.00
  ADJUSTMENT OF ACTUARIAL LIABILITY FOR
            ANNUITIES PAYABLE                                                                                         75,000.00
  EXPENDED FOR PLANT FACILITIES
  RETIREMENT OF INDEBTEDNESS
  INTEREST ON INDEBTEDNESS
  DISPOSAL OF PLANT FACILITIES
  EXPIRED TERM ENDOWMENTS                                                                           90,000.00
  MATURED ANNUITY AND LIFE INCOME FUNDS
            RESTRICTED TO ENDOWMENT                                                                                   10,000.00

   TOTAL EXPENDITURES AND OTHER DEDUCTNS 6,230,000.00      1,069,000.00           12,000.00         90,000.00        85,000.00

TRANSFERS AMONG FUNDS-ADDITIONS/(DEDUCT)
  MANDATORY
    PRINCIPAL AND INTEREST               (340,000.00)
    RENEWALS AND REPLACEMENTS            (170,000.00)
    LOAN FUND MATCHING GRANT               (2,000.00)                              2,000.00
  UNRESTRICTED GIFTS ALLOCATED           (650,000.00)                             50,000.00        550,000.00
  PORTION OF UNRESTRICTED QUASI-ENDOWMT
    FUNDS INVESTMENT GAINS APPROPRIATED     40,000.00                                              (40,000.00)

      TOTAL TRANSFERS                   (1,122,000.00)                            52,000.00        510,000.00

NET INCREASE/(DECREASE) FOR THE YEAR       188,000.00         25,000.00          181,000.00      2,099,000.00       715,000.00
FUND BALANCE AT BEGINNING OF YEAR          455,000.00        421,000.00          502,000.00     11,901,000.00     2,505,000.00
FUND BALANCE AT END OF YEAR                643,000.00        446,000.00          633,000.00     14,000,000.00     3,220,000.00
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EXHIBIT C

AICPA MODULE COMPONENTS

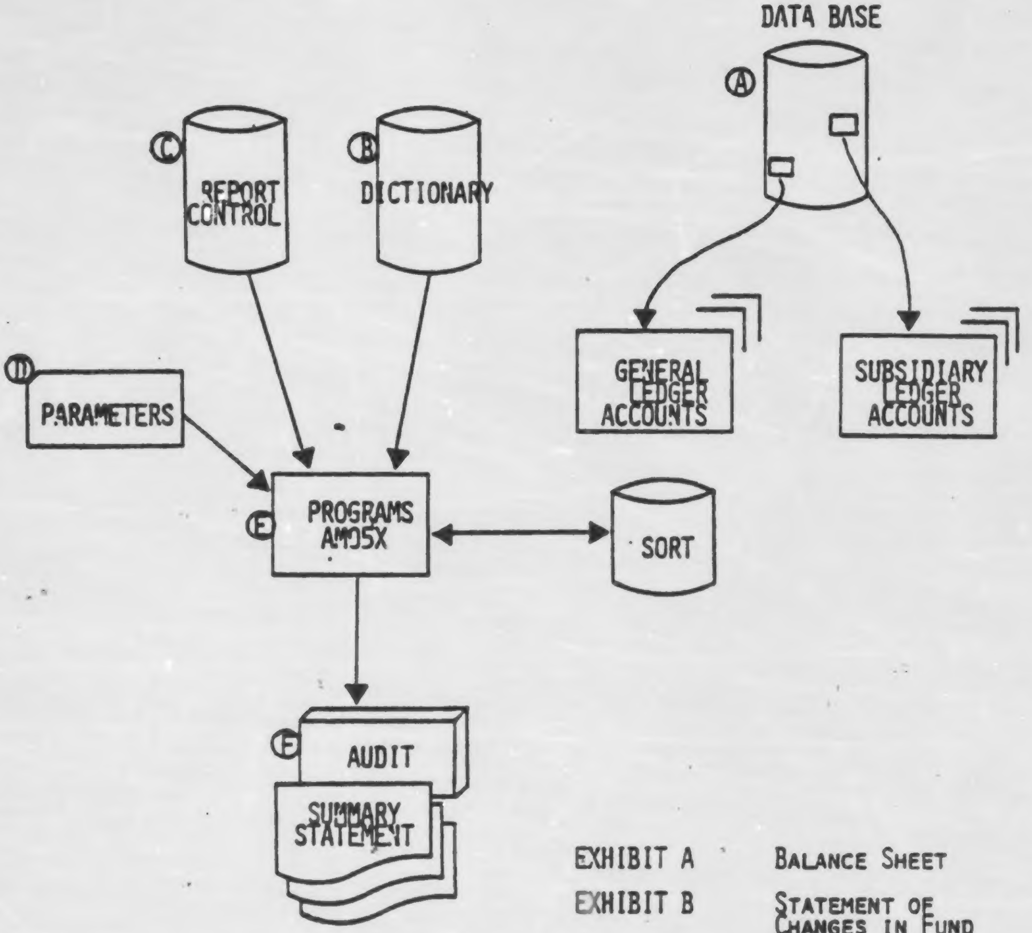

EXHIBIT A	BALANCE SHEET
EXHIBIT B	STATEMENT OF CHANGES IN FUND BALANCES
EXHIBIT C	STATEMENT OF CURRENT FUNDS REVENUES, EXPENDITURES AND OTHER CHANGES

FIGURE 4

TYPICAL LIST OF ATTRIBUTES

COMMON TO ALL OR MOST ACCOUNTS

- DESCRIPTION
- RESPONSIBLE PERSON
- SCHOOL IDENTITY
- DEPARTMENT IDENTITY
- DIVISION
- PREVIOUS ACCOUNT NUMBER
- GEOGRAPHIC LOCATION
- BUILDING LOCATION & ADDRESS
- REPORTING DATE

SPECIAL FOR GRANTS & CONTRACTS

- SPONSOR
- TYPE OF FUNDING
- PURPOSE
- BEGINNING DATE
- EXPIRATION DATE
- AGENCY
- SUB-AGENCY

OTHER

- PROGRAM IDENTITY
- SOURCE
- SHARE IN THE POOLED ENDOWMENT
- CONSTRUCTION PROJECT IDENTITY

FIGURE 5

```
COMPUTER DATE 11/29/78                     INFORMATION ASSOCIATES ACCOUNTING SYSTEM REPORT                                  REPORT PAGE    6
   TIME OF DAY 11:14:35                                                                                                      USER ID XX.1
PGM=AI001                                        DATA ELEMENT DESCRIPTION/VALUE LIST

GEN & SUB LEDGER ELEMENTS   POINTER = 019       LONG DESCRIPTION = SCHOOL CODE        SHORT DESCRIPTION = SCHL    UPDATABLE ELEMENT

                DEFINITION:      A CODE THAT IS USED TO REPRESENT EACH TYPE OF SCHOOL WITHIN A UNIVERSITY.

                COMMENTS:        THIS ATTRIBUTE MAY BE USED FOR REPORTING THE STATUS OF A.. ACCOUNTS
                                 WITHIN A PARTICULAR SCHOOL.

                VALUE:           > 01            ART & SCIENCE
                                 > 02            ENGINEERING
                                 > 03            BUSINESS ADMINISTRATION
                                 > 04            EDUCATION
                                 > 05            UNIVERSITY SCHOOL
                                 > 06            MEDICAL SCHOOL
                                 > 07            MUSIC
SUBSIDIARY LEDGER ELEMENTS  POINTER = 020       LONG DESCRIPTION = REVENUE PURPOSE    SHORT DESCRIPTION = REV     UPDATABLE ELEMENT

                DEFINITION:      AN IDENTIFIER THAT GROUPS FUNDS ACCORDING TO THE POINTS OF ORIGIN
                                 OF REVENUES.

                COMMENTS:        THIS ATTRIBUTE IS USED TO PRODUCE THE STATEMENT OF CURRENT FUNDS
                                 REVENUES, EXPENDITURES AND OTHER CHANGES (AN052).

                VALUE:           > 01.00        TUITION AND FEES
                                 > 02.00        FEDERAL APPROPRIATIONS
                                 > 03.00        STATE APPROPRIATIONS
                                 > 04.00        LOCAL APPROPRIATIONS
                                 > 05.00        FEDERAL GRANTS AND CONTRACTS
                                 > 06.00        STATE GRANTS AND CONTRACTS
                                 > 07.00        LOCAL GRANTS AND CONTRACTS
                                 > 08.00        PRIVATE GIFTS, GRANTS AND CONTRACTS
                                 > 09.00        ENDOWMENT INCOME
                                 > 10.00        SALES AND SERVICES OF EDUCATIONAL ACTIVITIES
                                 > 11.00        SALES AND SERVICES OF AUXILIARY ENTERPRISES
                                 > 12.00        SALES AND SERVICES OF HOSPITALS
                                 > 13.00        OTHER SOURCES
SUBSIDIARY LEDGER ELEMENTS  POINTER = 021       LONG DESCRIPTION = EXPENSE PURPOSE    SHORT DESCRIPTION = EXP     UPDATABLE ELEMENT

                DEFINITION:      AN INSTITUTIONALLY DEFINED CODE THAT GROUPS CURRENT FUNDS
                                 EXPENDITURES ACCORDING TO THE PURPOSE FOR WHICH COSTS WERE INCURRED.

                COMMENTS:        THIS ATTRIBUTE IS USED (ALONG WITH REVENUE PURPOSE) TO PRODUCE THE
                                 STATEMENT OF CURRENT FUNDS, REVENUES, EXPENDITURES, AND OTHER
                                 CHANGES (AN052).

                VALUES:          INSTRUCTION
                                 > 20.00        GENERAL ACADEMIC
                                 > 20.10          SPONSORED TRAINING PROGRAMS
                                 > 20.20          SPONSORED INSTITUTIONAL TRAINING SUPPORT
                                 > 20.30          SPONSORED RESEARCH TRAINING
                                 > 20.40          POSTDOCTORAL SUPPLY ALLOWANCE
                                 > 20.50          CAREER DEVELOPMENT AWARDS
                                 > 21.00        OCCUPATIONAL & VOCATIONAL
                                 > 22.00        SPECIAL SESSION (SUMMER)
                                 > 23.00        COMMUNITY EDUCATION (ONLY EXTENSION FOR CREDIT)
                                 > 24.00        COMMUNITY EDUCATION (NON CREDIT)
```

FIGURE 6

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COMPUTER DATE 10/19/78
   TIME OF DAY 19:50:29                                    FINANCIAL REPORTING SYSTEM
PGM=AXOOR                                                  REPORT DESCRIPTION FILE LIST
....V....1....V....2....V....3....V....4....V....5....V....6....V....7....V....8

AM195A01   C CURRENT FUNDS     STATE      APPROPRIATED      10                        1521
AM195A02   C  UNRESTRICTED SELF FUNDED    ACTIVITIES        10                        1522
AM195A03   C                              RESTRICTED        10                        1523
AM195A04   C                   LOAN          FUNDS          10                        1524
AM195A05   C    ENDOWMENT   AND SIMILAR      FUNDS          10                        1525
AM195A06   C                              UNEXPENDED   09                             1526
AM195A07   C    PLANT FUNDSRETIREMENT OF INDEBTEDNESS 09                              1527
AM195A08   C                 INVESTMENT    IN PLANT    09                             1528
AM195A09   C      TOTAL           PLANT      FUNDS          10                        1529
AM195A10   C                      GRAND      TOTAL                                    1530
AM195A0200H REVENUES AND OTHER ADDITIONS                                              1531
AM195A0210D-  STATE              APPROPRIATIONS        0280                           1532
AM195A0220D-  STUDENT TUITION                          0380                           1533
AM195A0230D-  INDIRECT COST REIMBURSEMENT              0380                           1534
AM195A0240D-  INVESTMENT REVENUES                      0380                           1535
AM195A0250D-  AUXILIARY OPERATING REVENUES             0380                           1536
AM195A0260D-  HOSPITALS                                0380                           1537
AM195A0270D-  GIFTS, GRANTS AND CONTRACTS              0280                           1538
AM195A0280H   SALES AND SERVICES OF EDUCATIONAL        0280                           1539
AM195A0290D-    DEPARTMENTS                            0380                           1540
AM195A0300D-  REALIZED GAIN (LOSS) ON INVESTMENTS      0280                           1541
AM195A0305D-  UNREALIZED GAIN (LOSS) ON INVESTMENTS    0380                           1542
AM195A0310D-  INTEREST ON LOANS RECEIVABLE             0280                           1543
AM195A0320D-  U. S. GOVERNMENT ADVANCES                0280                           1544
AM195A0330D-  ADDITIONS TO PLANT FACILITIES            0380                           1545
AM195A0340D-  RETIREMENT OF INDEBTEDNESS               0380                           1546
AM195A0350D-  PROCEEDS - REVENUE BOND ISSUE            0380                           1547
AM195A0360D-  OTHER SOURCES                            0280                           1548
AM195A0370H                                                                           1549
AM195A0380T-TOTAL REVENUES AND OTHER ADDITIONS         0670                           1550
AM195A0390H                                                                           1551
AM195A0400H EXPENDITURES AND OTHER DEDUCTIONS                                         1552
AM195A0410D   EDUCATIONAL AND GENERAL                  0530                           1553
AM195A0420D   INDIRECT COST RECOVERED                  0530                           1554
AM195A0430D   AUXILIARY OPERATING EXPENDITURES         0530                           1555
AM195A0440D   HOSPITALS                                0530                           1556
AM195A0450D   LOAN CANCELLATION AND WRITE OFFS         0530                           1557
AM195A0460D   ADMINISTRATIVE AND COLLECTION COSTS      0530                           1558
AM195A0470D   EXPENDED FOR PLANT FACILITIES            0530                           1559
AM195A0480D   RETIREMENT OF INDEBTEDNESS               0530                           1560
AM195A0490D   INTEREST ON INDEBTEDNESS                 0530                           1561
AM195A0500D   DISPOSAL OF PLANT FACILITIES             0530                           1562
AM195A0510D   ADDITION TO CONTRACTS PAYABLE            0530                           1563
AM195A0520H                                                                           1564
AM195A0530T TOTAL EXPENDITURES AND OTHER DEDUCTIONS 0640                              1565
AM195A0540E                                                                           1566
AM195A0550H TRANSFERS BETWEEN FUNDS - (ADD) DEDUCT                                    1567
AM195A0560H   MANDATORY TRANSFERS                                                     1568
AM195A0570D     PRINCIPAL AND INTEREST                 0610                           1569

....V....1....V....2....V....3....V....4....V....5....V....6....V....7....V....8
```

FIGURE 7

COMPUTER DATE 11/15/78
TIME OF DAY 23:25:25
PGM-AP195

FINANCIAL REPORTING SYSTEM
STATEMENT OF CHANGES IN FUND BALANCES
AS OF 06/30/78

REPORT PAGE 6[illegible]
USER ID 29.1
CAMPUS- 4

	CURRENT FUNDS STATE APPROPRIATED	UNRESTRICTED SELF FUNDED ACTIVITIES	RESTRICTED	LOAN FUNDS	ENDOWMENT AND SIMILAR FUNDS
REVENUES AND OTHER ADDITIONS					
STATE APPROPRIATIONS	3,404,480.70				
STUDENT TUITION	1,780,979.86				
INDIRECT COST REIMBURSEMENT	29,886.12				
INVESTMENT REVENUES		5,205.28	5,226.69	9,333.91	
AUXILIARY OPERATING REVENUES		774,945.83			
HOSPITALS					
GIFTS, GRANTS AND CONTRACTS		42,305.07	1,719,071.77		
SALES AND SERVICES OF EDUCATIONAL DEPARTMENTS		137,085.36			
REALIZED GAIN (LOSS) ON INVESTMENTS					
UNREALIZED GAIN (LOSS) ON INVESTMENTS				5,3[illegible]0.5[illegible]	
INTEREST ON LOANS RECEIVABLE				1,324.46	
U. S. GOVERNMENT ADVANCES				146,[illegible]0[illegible].00	
ADDITIONS TO PLANT FACILITIES					
RETIREMENT OF INDEBTEDNESS					
PROCEEDS - REVENUE BOND ISSUE					
OTHER SOURCES	60,444.38			125.00	
TOTAL REVENUES AND OTHER ADDITIONS	5,275,791.04	959,621.54	1,724,298.46	150,737.92	
EXPENDITURES AND OTHER DEDUCTIONS					
EDUCATIONAL AND GENERAL	5,166,217.61	184,078.31	1,571,813.25		
INDIRECT COST RECOVERED			18,575.84	9,812.88	
AUXILIARY OPERATING EXPENDITURES		710,139.20			
HOSPITALS					
LOAN CANCELLATION AND WRITE OFFS				3,030.85	
ADMINISTRATIVE AND COLLECTION COSTS				218.08	
EXPENDED FOR PLANT FACILITIES					
RETIREMENT OF INDEBTEDNESS					
INTEREST ON INDEBTEDNESS					
DISPOSAL OF PLANT FACILITIES					
ADDITION TO CONTRACTS PAYABLE					
TOTAL EXPENDITURES AND OTHER DEDUCTIONS	5,166,217.61	894,217.51	1,590,389.13	13,061.81	
TRANSFERS BETWEEN FUNDS - (ADD) DEDUCT					
MANDATORY TRANSFERS					
PRINCIPAL AND INTEREST		76,715.00			
DEBT SERVICE RESERVE		5,015.00			
RENEWALS AND REPLACEMENTS					
MATCHING FUNDS			79,578.00	(79,578.00)	
TOTAL MANDATORY TRANSFERS		81,730.00	79,578.00	(79,578.00)	
VOLUNTARY TRANSFERS	15.00	8,301.00	(1,849.59)		
TOTAL EXPENDITURES, OTHER DEDUCTIONS AND TRANSFERS	5,166,232.61	984,248.51	1,668,117.54	(65,716.19)	
NET INCREASE (DECREASE) IN FUND BALANCES	109,558.43	(24,626.97)	57,180.92	224,45[illegible].11	
FUND BALANCES					

FIGURE 8

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COMPUTER DATE 11/13/78
   TIME OF DAY 23:24:25                              FINANCIAL REPORTING SYSTEM
PGM=AM195                             STATEMENT OF CHANGES IN FUND BALANCES - AUDIT TRAIL
                                                         AS OF 06/30/78

  COLUMN    LINE NO   ACCOUNT NO      ACCOUNT DESCRIPTION      DOLLAR DESCRIPTION            Y-T-D ACTUALS

     3       07.20    4-0-40000-340     FEDERAL WORK-STUDY       FUND BAL-CUR RES-OTH               12,899.63
     3       07.20    4-0-40010-340     FED WRK-STDY ON-CMPS     FUND BAL-CUR RES-OTH               17,963.16-
     3       07.20    4-0-40020-340     FED WRK-STDY OFF-CMP     FUND BAL-CUR RES-OTH                3,361.40-
     3       07.20    4-0-40060-340     LAW ENFORC EDUC PROG     FUND BAL-CUR RES-OTH                6,096.50-
     3       07.20    4-0-40620-340     CETA TITLE VI 77-253     FUND BAL-CUR RES-OTH                    7.00
     3       07.20    4-0-40630-340     BASIC EDUC OPPT GRNT     FUND BALANCE                       36,890.74-
     3       07.20    4-0-41000-340     ST WORK-STDY NC NEED     FUND BAL-CUR RES-OTH                   79.20-
     3       07.20    4-0-41010-340     ST WORK-STUDY NEED       FUND BAL-CUR RES-OTH                   74.16-
     3       07.20    4-0-41030-340     UNFUNDED STUDENT AID     FUND BAL-CUR RES-OTH                1,203.72-
     3       07.20    4-0-42020-340     UNRESTRICTED GIFTS       FUND BAL-CUR RES-OTH                1,073.29-
     3       07.20    4-0-42050-340     STUDENT FACILITIES       FUND BAL-CUR RES-OTH               17,786.01-
     3       07.20    4-0-42080-340     COLLEGE OF LAS GIFTS     FUND BAL-CUR RES-OTH                   38.41-
     3       07.20    4-0-42090-340     POLLINATOR DECIMATN      FUND BAL-CUR RES-OTH                  122.92-
     3       07.20    4-0-42100-340     ENGINEERING GIFTS        FUND BAL-CUR RES-OTH                4,144.98-
     3       07.20    4-0-42110-340     TEACHER CORPS            FUND BAL-CUR RES-OTH                1,689.36-
     3       07.20    4-0-42120-340     EDUCATION GIFTS          FUND BAL-CUR RES-OTH                   12.10-
     3       07.20    4-0-42130-340     CO CHLD BK AWD-SP GF     FUND BAL-CUR RES-OTH                1,627.34-
     3       07.20    4-0-42150-340     COLL OF BUS GIFTS        FUND BAL-CUR RES-OTH                4,427.58-
     3       07.20    4-0-42170-340     LIBRARY GIFTS            FUND BAL-CUR RES-OTH                3,555.35-
     3       07.20    4-0-42180-340     ISKIYAN EST GIFT-PRN     FUND BAL-CUR RES-OTH               77,215.28-
     3       07.20    4-0-42190-340     CNCL LIB RES GRANT       FUND BAL-CUR RES-OTH                   31.32-
     3       07.20    4-0-42210-340     MISC SCHLRSHP CLR        FUND BAL-CUR RES-OTH                6,994.62-
     3       07.20    4-0-42220-340     BUS CLUB SCHLRSHIP       FUND BAL-CUR RES-OTH                    3.86-
     3       07.20    4-0-42290-340     COLO CHLDRN'S BK AWD     FUND BAL-CUR RES-OTH                1,244.48-
     3       07.20    4-0-42310-340     DOROTHY MOORE MEMORL     FUND BALANCE                        1,822.30-
     3       07.20    4-0-42320-340     CENTER FOR ECON EDUC     FUND BALANCE                          403.05-

                                             END OF YEAR                                        181,065.34-

     4       02.40    4-0-51110-414     RAY LIND-PRIN UCCS       INVESTMENT REVENUE                    327.38-
     4       02.40    4-0-52030-414     GARMAN SHORT-TERM LN     INVESTMENT REVENUE                  2,530.71-
     4       02.40    4-0-52040-414     TERRY HOOVER MEM LN      INVESTMENT REVENUE                  1,247.82-
     4       02.40    4-0-52050-414     GARMAN PRINCIPAL         INVESTMENT REVENUE                  1,228.00-

                                           INVESTMENT REVENUES                                    5,333.91-

     4       03.05    4-0-52050-422                              UNREALIZED GAIN/LOSS                5,350.55-
```

FIGURE 9

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COMPUTER DATE 10/19/78                                                                          REPORT PAGE    2
  TIME OF DAY 10:35:10                                                                          USER ID 48.1
PGM=AM055                                               EDIT REPORT

REPORT     LINE      LINE   NEG
 TYPE      NUMBER    TYPE   SW    -------ADD TO LINES-------        DESCRIPTION

AM055-A    01.00      H           00.00  00.00  00.00  00.00    REVENUES
AM055-A    02.00      D           15.00  00.00  00.00  00.00    TUITION & FEES
AM055-A    03.00      D           15.00  00.00  00.00  00.00    FEDERAL APPROPRIATIONS
AM055-A    04.00      D           15.00  00.00  00.00  00.00    STATE APPROPRIATIONS
AM055-A    05.00      D           15.00  00.00  00.00  00.00    LOCAL APPROPRIATIONS
AM055-A    06.00      D           15.00  00.00  00.00  00.00    FEDERAL GRANTS & CONTRACTS
AM055-A    07.00      D           15.00  00.00  00.00  00.00    STATE GRANTS & CONTRACTS
AM055-A    08.00      D           15.00  00.00  00.00  00.00    LOCAL GRANTS & CONTRACTS
AM055-A    09.00      D           15.00  00.00  00.00  00.00    PRIVATE GIFTS, GRANTS & CONTRACTS
AM055-A    10.00      D           15.00  00.00  00.00  00.00    ENDOWMENT INCOME
AM055-A    11.00      D           15.00  00.00  00.00  00.00    SALES & SERVICES - EDUCATIONAL DEPTS.
AM055-A    12.00      D           15.00  00.00  00.00  00.00    SALES & SERVICES - AUXILIARY ENTERPRISES
AM055-A    13.00      D           15.00  00.00  00.00  00.00    EXPIRED TERM ENDOWMENT
AM055-A    14.00      D           15.00  00.00  00.00  00.00    OTHER SOURCES OF REVENUE
AM055-A    15.00      T           50.00  00.00  00.00  00.00    TOTAL CURRENT REVENUES
AM055-A    16.00      H           00.00  00.00  00.00  00.00
AM055-A    17.00      H           00.00  00.00  00.00  00.00
AM055-A    18.00      H           00.00  00.00  00.00  00.00    EXPENDITURES AND MANDATORY TRANSFERS
AM055-A    19.00      H           00.00  00.00  00.00  00.00    EDUCATIONAL & GENERAL
AM055-A    20.00      D           29.00  00.00  00.00  00.00    INSTRUCTION
AM055-A    21.00      D           29.00  00.00  00.00  00.00    RESEARCH
AM055-A    22.00      D           29.00  00.00  00.00  00.00    PUBLIC SERVICE
AM055-A    23.00      D           29.00  00.00  00.00  00.00    ACADEMIC SUPPORT
AM055-A    24.00      D           29.00  00.00  00.00  00.00    LIBRARY
AM055-A    25.00      D           29.00  00.00  00.00  00.00    STUDENT SERVICES
AM055-A    26.00      D           29.00  00.00  00.00  00.00    INSTITUTIONAL SUPPORT
AM055-A    27.00      D           29.00  00.00  00.00  00.00    OPERATION & MAINTENANCE OF PLANT
AM055-A    28.00      D           29.00  00.00  00.00  00.00    SCHOLARSHIPS & FELLOWSHIPS
AM055-A    29.00      T           35.00  00.00  00.00  00.00    TOTAL EDUCATIONAL & GENERAL EXPENDITURES
AM055-A    30.00      H           00.00  00.00  00.00  00.00
AM055-A    31.00      H           00.00  00.00  00.00  00.00    MANDATORY TRANSFERS FOR
AM055-A    32.00      D           35.00  00.00  00.00  00.00    PRINCIPAL & INTEREST
AM055-A    33.00      D           35.00  00.00  00.00  00.00    RENEWALS & REPLACEMENTS
AM055-A    34.00      D           35.00  00.00  00.00  00.00    LOAN FUND MATCHING GRANT
AM055-A    35.00      T           43.00  00.00  00.00  00.00    TOTAL EDUCATIONAL & GENERAL
AM055-A    36.00      H           00.00  00.00  00.00  00.00
AM055-A    37.00      H           00.00  00.00  00.00  00.00    AUXILIARY ENTERPRISES
AM055-A    38.00      D           42.00  00.00  00.00  00.00    EXPENDITURES
AM055-A    39.00      H           00.00  00.00  00.00  00.00    MANDATORY TRANSFERS FOR
AM055-A    40.00      D           42.00  00.00  00.00  00.00    PRINCIPAL & INTEREST
AM055-A    41.00      D           42.00  00.00  00.00  00.00    RENEWALS AND REPLACEMENTS
AM055-A    42.00      T           43.00  00.00  00.00  00.00    TOTAL AUXILIARY ENTERPRISES
AM055-A    43.00      T           50.00  00.00  00.00  00.00    TOTAL EXPENDITURES & MANDATORY TRANSFERS
AM055-A    44.00      H           00.00  00.00  00.00  00.00
AM055-A    45.00      H           00.00  00.00  00.00  00.00
AM055-A    46.00      H           00.00  00.00  00.00  00.00    OTHER TRANSFERS & (ADDITIONS)/DEDUCTIONS
AM055-A    47.00      D           50.00  00.00  00.00  00.00    EXCESS - RSTR REC OVER TRANSF TO REVN
AM055-A    48.00      D           50.00  00.00  00.00  00.00    REFUNDED TO GRANTORS
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FIGURE 10

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COMPUTER DATE 10/05/78                                                                                      REPORT PAGE
  TIME OF DAY 19:57:33                                                                                      USER ID 48.1
PGM#ANQ55                   STATEMENT OF CURRENT FUNDS REVENUES, EXPENDITURES, AND OTHER CHANGES
                                          FOR THE 12 MONTHS ENDED 09/78

                                          = = = = = = = = = = = = = =CURRENT YEAR= = = = = = = = = = = = = =        PRIOR
                                                 UNRESTRICTED         RESTRICTED              TOTAL                 YEAR TOTAL

REVENUES
   TUITION & FEES                               15,672,556.31                .00          15,672,556.31                .00
   FEDERAL APPROPRIATIONS                          175,147.78      10,895,659.98          11,070,807.76                .00
   STATE APPROPRIATIONS                         58,385,075.08                .00          58,385,075.08                .00
   LOCAL APPROPRIATIONS                                   .00       1,797,016.75           1,797,016.75                .00
   FEDERAL GRANTS & CONTRACTS                      951,663.70       6,531,585.95           7,483,249.65                .00
   STATE GRANTS & CONTRACTS                        193,971.00       2,040,137.84           2,234,108.84                .00
   LOCAL GRANTS & CONTRACTS                        218,268.21         541,790.54             760,058.75                .00
   PRIVATE GIFTS, GRANTS & CONTRACTS                96,207.85       2,000,329.43           2,096,537.28                .00
   ENDOWMENT INCOME                                584,454.45         146,009.00             730,463.87                .00
   SALES & SERVICES - EDUCATIONAL DEPTS.         8,729,624.53                .00           8,729,624.53                .00
   SALES & SERVICES - AUXILIARY ENTERPRISES     13,143,192.69                .00          13,143,192.69                .00
   EXPIRED TERM ENDOWMENT                                 .00                .00                    .00                .00
   OTHER SOURCES OF REVENUE                      2,486,232.81         493,976.72           2,980,209.53                .00
   TOTAL CURRENT REVENUES                       97,636,394.85      24,466,506.29         121,882,901.16                .00

   EXPENDITURES AND MANDATORY TRANSFERS
   EDUCATIONAL & GENERAL
   INSTRUCTION                                  36,056,962.73         471,226.66          36,528,189.39                .00
   RESEARCH                                     10,308,324.72       7,653,842.87          17,962,167.59                .00
   PUBLIC SERVICE                                9,404,885.48      15,344,278.12          24,749,163.60                .00
   ACADEMIC SUPPORT                              8,021,423.85          20,657.19           8,042,081.04                .00
   LIBRARY                                       3,042,123.14           8,982.01           3,051,105.15                .00
   STUDENT SERVICES                              3,837,949.26          28,355.21           3,866,304.47                .00
   INSTITUTIONAL SUPPORT                         4,705,377.13           9,560.02           4,714,937.15                .00
   OPERATION & MAINTENANCE OF PLANT              8,775,568.72                .00           8,775,568.72                .00
   SCHOLARSHIPS & FELLOWSHIPS                       58,382.48         909,604.21             967,986.69                .00
   TOTAL EDUCATIONAL & GENERAL EXPENDITURES     81,210,997.51      24,446,506.29         105,657,503.80                .00

   MANDATORY TRANSFERS FOR
   PRINCIPAL & INTEREST                            884,493.29            313.51)             884,179.78                .00
   RENEWALS & REPLACEMENTS                                .00                .00                    .00                .00
   LOAN FUND MATCHING GRANT                               .00                .00                    .00                .00
   TOTAL EDUCATIONAL & GENERAL                  82,095,490.80      24,446,192.78         106,541,683.58                .00

   AUXILIARY ENTERPRISES
   EXPENDITURES                                 13,660,953.09                .00          13,660,953.09                .00
   MANDATORY TRANSFERS FOR
   PRINCIPAL & INTEREST                            697,522.16                .00             697,522.16                .00
   RENEWALS AND REPLACEMENTS                              .00                .00                    .00                .00
   TOTAL AUXILIARY ENTERPRISES                  14,358,475.25                .00          14,358,475.25                .00

   TOTAL EXPENDITURES & MANDATORY TRANSFERS     96,453,966.05      24,446,192.78         120,900,158.83                .00

   OTHER TRANSFERS & (ADDITIONS)/DEDUCTIONS
   EXCESS - RSTR REC OVER TRANSF TO REVN                  .00       2,018,342.94           2,018,342.94                .00
```

FIGURE 11

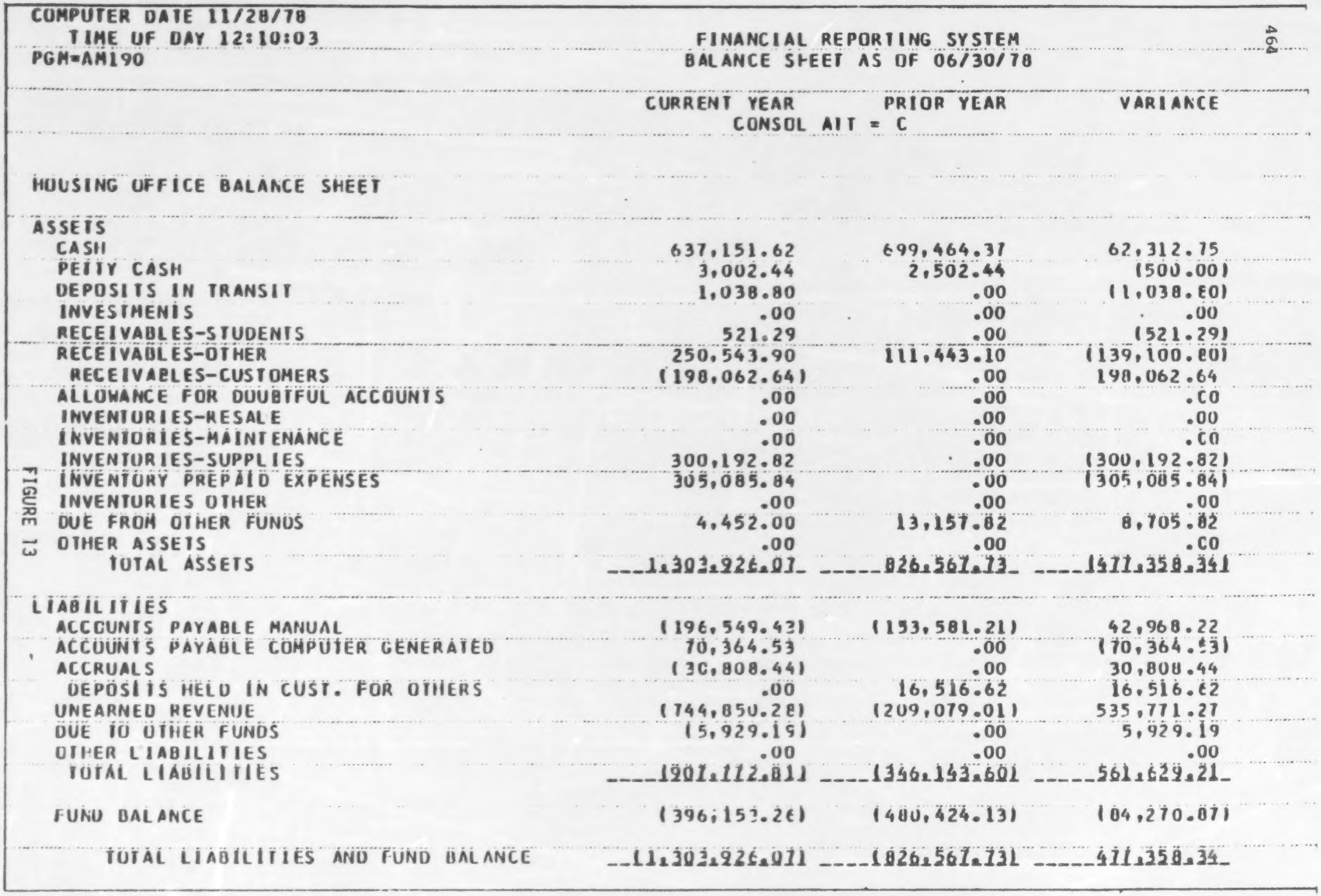
COMPUTER DATE 10/05/78
TIME OF DAY 17:00:20
PGM-AM055

REPORT PAGE 98
USER ID 48.1

AUDIT TRAIL FOR STATEMENT OF CURRENT FUND REVENUES, EXPENDITURES AND TRANSFERS
FOR THE 12 MONTHS ENDED 09/78

LINE-NO	ACCOUNT NO	ACCOUNT DESCRIPTION	DOLLAR DESCRIPTION	UNRESTRICTED	RESTRICTED
03.00	5-36500-399	TI SPEC DMINE	OTH GEN EXPENSES		124,880.00-
03.00	5-36900-150	CIVIL SERV RET	EMPL BENEFITS		
03.00	5-36950-150	EMP BEN CES FSL	EMPL BENEFITS		
03.00	5-36950-184		CIVIL SERV RET		606,244.99-
FEDERAL APPROPRIATIONS				175,147.78-	10,895,458.98-
04.00	1-11501-020	MAINT SUP DEVEL	GOVT. APP.		
04.00	1-11501-022		STATE APP	30,025,072.00-	
04.00	1-11502-020	ED IV	GOVT. APP.		
04.00	1-11502-022		STATE APP	320,062.00-	
04.00	1-11502-099		OTHER INCOME		
04.00	1-11503-020	ENG EXPM ST	GOVT. APP.		
04.00	1-11503-022		STATE APP	306,764.00-	
04.00	1-11504-020	INT LAND GRANT	GOVT. APP.		
04.00	1-11504-022		STATE APP	20,280.00-	
04.00	1-11505-020	PSYCHOL TRAINING	GOVT. APP.		
04.00	1-11505-022		STATE APP	100,000.00-	
04.00	1-11506-020	PUB SER RES EXT	GOVT. APP.		
04.00	1-11506-022		STATE APP	100,000.00-	
04.00	1-11507-020	VOC TEACH ED TNG	GOVT. APP.		
04.00	1-11507-022		STATE APP	125,000.00-	
04.00	1-11508-022	TEACHERS RETIRE	STATE APP	6,676,834.72-	
04.00	1-11509-022	SOCIAL SECURITY	STATE APP	1,726,271.95-	
04.00	1-21501-020	MAINT SUPT & DEV	GOVT. APP.		
04.00	1-21501-022		STATE APP	6,532,460.00-	
04.00	1-21501-075		OTHER REVENUES		
04.00	1-21501-098		BALANCE FWD		
04.00	1-21501-099		OTHER INCOME		
04.00	1-21502-020	MTGY COMM HLTH	GOVT. APP.		
04.00	1-21502-022		STATE APP	120,541.00-	
04.00	1-21502-025		GIFTS+GRNTS+CONT		
04.00	1-21502-031		FOUND/ASSOC.GIFT	900.00-	
04.00	1-21502-032		INDIV GIFT/GRNT		
04.00	1-21504-027	CTR FOR BUS 888	STATE GRNT/CONTR		
04.00	1-21505-020	PUB SERV-RES-EXT	GOVT. APP.		
04.00	1-21505-022		STATE APP	50,000.00-	
04.00	1-22450-022	TEACHER RET	STATE APP	525,981.85-	
04.00	1-22455-022	SOCIAL SECURITY	STATE APP	213,569.36-	
04.00	1-31501-020	AES STATE APP	GOVT. APP.		
04.00	1-31501-022		STATE APP	6,343,147.00-	
04.00	1-32450-022	TEACHERS RET AES	STATE APP	788,401.58-	
04.00	1-32455-022	SOCIAL SCTY AES	STATE APP	309,239.79-	
04.00	1-41501-020	ST SMITH LEVER	GOVT. APP.		
04.00	1-41501-022		STATE APP	6,831,234.00-	
04.00	1-41502-020	EMP RETIRE CES	GOVT. APP		

FIGURE 12



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COMPUTER DATE 11/28/78
   TIME OF DAY 12:10:03                         FINANCIAL REPORTING SYSTEM
PGM=AM190                                      BALANCE SHEET AS OF 06/30/78

                                               CURRENT YEAR          PRIOR YEAR            VARIANCE
                                                          CONSOL AIT = C

HOUSING OFFICE BALANCE SHEET

ASSETS
  CASH                                           637,151.62          699,464.37           62,312.75
  PETTY CASH                                       3,002.44            2,502.44            (500.00)
  DEPOSITS IN TRANSIT                              1,038.80                 .00          (1,038.80)
  INVESTMENTS                                           .00                 .00                 .00
  RECEIVABLES-STUDENTS                               521.29                 .00            (521.29)
  RECEIVABLES-OTHER                              250,543.90          111,443.10        (139,100.80)
   RECEIVABLES-CUSTOMERS                        (198,062.64)                .00          198,062.64
  ALLOWANCE FOR DOUBTFUL ACCOUNTS                       .00                 .00                 .00
  INVENTORIES-RESALE                                    .00                 .00                 .00
  INVENTORIES-MAINTENANCE                               .00                 .00                 .00
  INVENTORIES-SUPPLIES                           300,192.82                 .00        (300,192.82)
  INVENTORY PREPAID EXPENSES                     305,085.84                 .00        (305,085.84)
  INVENTORIES OTHER                                     .00                 .00                 .00
  DUE FROM OTHER FUNDS                             4,452.00           13,157.82            8,705.82
  OTHER ASSETS                                          .00                 .00                 .00
      TOTAL ASSETS                          ___1,303,926.07_ _____826,567.73_ ____(477,358.34)

LIABILITIES
  ACCOUNTS PAYABLE MANUAL                       (196,549.43)        (153,581.21)          42,968.22
  ACCOUNTS PAYABLE COMPUTER GENERATED             70,364.53                 .00         (70,364.53)
  ACCRUALS                                       (30,808.44)                .00           30,808.44
   DEPOSITS HELD IN CUST. FOR OTHERS                    .00           16,516.62           16,516.62
  UNEARNED REVENUE                              (744,850.28)        (209,079.01)         535,771.27
  DUE TO OTHER FUNDS                              (5,929.19)                .00            5,929.19
  OTHER LIABILITIES                                     .00                 .00                 .00
   TOTAL LIABILITIES                        ____(907,772.81) ____(346,143.60) _____561,629.21_

  FUND BALANCE                                  (396,153.26)        (480,424.13)         (84,270.87)

      TOTAL LIABILITIES AND FUND BALANCE    __(1,303,926.07) ____(826,567.73) _____477,358.34_
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FIGURE 13

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COMPUTER DATE 11/20/78
   TIME OF DAY 12:02:01                          FINANCIAL REPORTING SYSTEM
PGM=AM190                                       BALANCE SHEET AS OF 06/30/78

                                            CURRENT YEAR      PRIOR YEAR          VARIANCE
                                                  CONSOL ATT = A
 ATHLETIC DEPT BALANCE SHEET

ASSETS
  EQUITY IN UNIV TREAS POOLED ASSETS        1,799,556.86    1,194,372.45      (605,184.41)
  CASH ON HAND                                    300.00          200.00          (100.00)
  ACCOUNTS RECEIVABLE                          19,568.04         (33.60)       (19,601.64)
  INVENTURIES                                        .00             .00               .00
  PREPAID EXPENSES                                   .00             .00               .00
  DUE FROM OTHER FUNDS                               .00             .00               .00
  INTERCAMPUS RECEIVABLES                            .00             .00               .00
  OTHER ASSETS                                  7,294.00             .00        (7,294.00)
      TOTAL ASSETS                       ___1,826,718.90_ ___1,194,538.85_ ____(632,180.05)

LIABILITIIES AND FUND BALANCE
  LIABILITIES
     ACCOUNTS PAYABLE                          (9,154.80)      (7,945.97)         1,208.83
     ACCRUED PAYROLL                           (1,820.99)      (2,340.02)          (519.03)
     UNEARNED REVENUE                      (1,794,516.00)  (1,321,315.24)       473,200.76
     DUE TO OTHER FUNDS                              .00             .00               .00
     OTHER LIABILITIES                               .00             .00               .00
      TOTAL LIABILITIES                  __(1,805,491.79) __(1,331,601.23) _____473,890.56_

  FUND BALANCE                                (21,227.11)     137,062.38        158,289.49

      TOTAL LIABILITIES AND FUND BALANCE __(1,826,718.90) __(1,194,538.85) _____632,180.05_
```

FIGURE 14

STUDENT REGISTRATION: An Innovative Mini-computer Approach for the Modern University

By
Donald W. Clark
Central Washington University
Ellensburg, Washington 98926

In Fall Quarter 1975, Central Washington University implemented an on-line interactive Student Registration System utilizing a PDP 11/45 mini-computer which has proven so successful that many institutions across the country are examining the approach and considering a similar system. Similar in design to the airline reservation concept, the system allows for mass registration of up to 10,000 students by pre-scheduled appointment over two (8) hour days. The students have access to advising from faculty at the time of registration. In addition to advising during registration, some of the innovative features include; the ability during registration to change seat size, add courses, delete courses, inquire about courses, and a closed circiut TV linkage to allow broadcasting of registration progress across the campus.

Another feature is that the system with minor modifications is independent of registration style or philosophy, for instance the same system can accommodate pre-registration or even a demand system approach. The (20) terminals used during registration are manned by clerical and secretarial personnel from departments on campus. The training time for the terminal operators is about 15 minutes.

The terminals used during registration are borrowed from user departments and returned at the end of registration. The total one-time cost of the complete system paid for itself in less than three years. When you consider cost versus performance this system is unequaled.

Background

Prior to September 1975, the CWU registration process consisted of a mass registration held in the institution's Physical Education Pavilion. Once each quarter the students and faculty gathered for the carnival style ritual of standing in long lines and three inches of dust (floors were removed to protect gym floor) to collectively accomplish the registration process. Each academic department was given a table which included a handsomely water colored sign indentifing them to prospective students. The student was required to stand in line in front of each table and wait his/her turn to receive a computer class card which entitled admission to the desired class. It was entirely possible to stand in line for half an hour only to learn that the student in front of you received the last class card.

An RCA Spectra 70/45 DOS system computer was used in support of this system but was rendered useless because of its limited capacity and the card orientation philosophy of the mass registration process. The old student records system required approximately 400,000 pre-punched cards per quarter to perform registration alone. Needless to say the system was unresponsive to the reporting requirements of administration, Legislature, and Office of Fiscal Management which reviews all budget requests.

In early 1974, Central Washington University found itself faced with a severely impacted computing capability and a legislative mandate requiring consolidation of computing in the State of Washington. In view of the mandate and by virtue of it's limited and exhausted computing resources Central decided to pioneer networking by off-loading it's academic and administrative work from the Spectra 70/45 DOS system to one or more state service centers. At the same time, guided by the desire for improved responsiveness in the student information system and recognizing the failure cost of a networked registration process, Central implemented an on-line interactive student information system using a large mini. I would like then to share with you some of the problems we encountered and the circumstances leading to the choice of the mini computer solution and how that choice exceeded our greatest expectations for the registration process.

Goals of the New System

The primary goal of the new system can best be described with the age old (tired) expression "to improve the overall responsiveness of registration while reducing support costs". Every effort was made to solicit input from everyone affected by the system while restraining any preconceived limitations placed on us by the existing system. Student surveys were conducted yielding some anticipated and yet some unanticipated results. The time required to register for classes was of critical importance to most students surveyed. In addition, students were interested in more visibility of class availability at the time of registration. The unanticipated recommendation from students involved advising from the faculty during registration. This could better be defined as the ability to discuss course content and/or requirements and last minute individual scheduling problems with faculty members. This was surprising to the system planners because it came at a time when most institutions were moving to the more simplified "mark the sheet and drop it in the box" approach to registration. This was also of concern to some of us who felt that the greatest reductions in support costs could best be realized through the elimination of the labor intensive mass registration process. The faculty on the other hand were divided on the approach to registration. The opinions of the faculty ranged anywhere from "I like it the way it is now" to a sophisticated telephone registration system similar to airline reservation systems. The administration didn't really care how it was done as long as it reduced costs, improved responsiveness, and satisfied the needs of the institution, students and faculty.

An institutional task force assigned to study long range goals had recommended two years earlier that institutional requirements for student information could best be met through on-line update and inquiry techniques. In the final analysis the institutional philosophy of registration was to register 6,000 to 7,000 students over two days with academic advising available at the time of registration and to allow for notification of closed classes as well as allow for section size changes, class additions, deletions and fees calculated during the registration process.

Selection and Development of the System

As mentioned earlier, much of Central's registration philosophy was developed through a concentrated two-year study of existing systems and incorporating input from students, faculty and administrators. Although most batch systems that were studied offered the necessary flexibility to meet changing requirements and growth, they lack the responsiveness outlined in the institutional requirements. Many of the on-line student records systems that were studied appeared to meet most of our needs but required significant hardware investments or were adequate only for small institutions. Cost effective, or perhaps a more appropriate term is affordable and efficient, on line student records systems for medium sized institutions (6,000-9,000 FTE) seemed nonexistant. Further study indicated several small private institutions were using mini computers very effectively to satisfy their student information requirements. The mini appeared to provide big computer power at incredibly low cost.

Close examination of the Digital Equipment Corporation PDP 11/45 mini computer and student records system at Seattle Pacific University convinced us to seek approval to purchase their software and similar equipment in hopes of minimizing as much effort and risk as possible.

The only undemonstrated feature was the ability of the mini computer to provide adequate response time given a significantly larger work load. For example SPU registered on-line about 2,500 students over a five day period and Central would attempt to register 6,000 to 7,000 on-campus students in two (8) hour days. The vendor was asked to demonstrate via benchmark the ability to register not less than (6) students per minute using (15) terminals simultaneously. A series of scripts were developed simulating an estimated number of interactions with each registrant and incorporating built-in delays to account for terminal operator response time. The mini exceeded our requirements by providing simulation success close to 10 students per minute.

In June 1975, we received approval to acquire the system and the SPU software. We began software modification and development in July, installed the computer in August and performed the first registration in September 1975.

System - Functional Characteristics

Although the subject of this paper concerns itself with the registration process I will briefly describe the other components of the system to enable you to better understand the complete student information system. The other functions serviced by the on-line capabilities of the system are the Admissions process, Fee Accounting, Financial Aids, Student Accounting, Housing and Food Services, Academic Advising, Graduate Office, Dean of Students and the Campus Telephone Office (see figure I). In the Admissions process the applicant file is separate and distinct from the student master file to provide better control over applicant flow data and adherence to institutional Admissions requirements. Throughout the student information system, design emphasis was given to the functional relationships of data elements to improve the interaction efficiency with users of the system. In other words, in a real-time environment, time dependent data requiring an output response was identified and performed automatically to minimize the amount of user intervention. A brief example might be: suppose an applicant for admission to the institution has completed all of the admission requirements and is accepted for admission. The computer will automatically produce an admission acceptance form to be mailed to the student along with the assignment and notification of advisor in addition to alerting and provided mailing information to the Housing Office and Financial Aids Office.

The entire software is written in Digital Equipment Corporation's (DEC) Basic Plus Language and runs on a DEC PDP 11/45 computer system under the RSTS/E (Resource Sharing, Time Sharing/Extended) version 6C operating system. The computer system is described in Figure 2. The student master file is randomly organized based on the last 4 digits of the student I. D. number (Social Security Number). The data elements were selected and defined with adherence to NCHEMS standards and for ease of interface with I. E. P. planning management systems.

Through a command program called "Dispatcher" we designed into the system a simplified user interface. After the user logs into the system the work "Command" appears on the screen and then through simple English statements the user is chained into and out of desired application programs (See Figure 3).

Registration Process

The new registration system was designed to retain the informal, personal aspects of the old procedure by continued presence of academic department advisors at the registration scene. This allows students to have ready access to faculty members for course sign-up counseling. All of the registration activities were moved from the atheletic pavilion to the ballroom of the Student Union Building. The ballroom is set up with (15) DEC VT50 Terminals for the Registrar's use, and (1) DEC VT05 Terminal for displaying closed classes (see Figure 4). The VT05 used for displaying closed classes broadcasts to eight TV monitors stationed throughout the Student Union Building and links to the local closed circiut TV allowing broadcasting of information into the dorms and local community. A program is being developed which will allow the university television station to interrupt the closed class signal from the computer to broadcast special information about new course offerings. Another program is being developed to be broadcast prior to registration to familiarize new students with the registration procedure.

The 14 VT50's used for the registration activity are dedicated to that one activity. They are manned by secretarial and office personnel from on campus and are logged in under a special account and password so that they are operative only for the registration function. The 3 VT50's for the Registrar's use are logged in under the Registrar's normal account and password and have access to all his normal service plus registration. These terminals are used to clear holds on students owing money from previous quarters, to clear residency, suspension, etc., which may affect a student's registration progress, In addition, one VT50 is used to allow faculty to add new classes, close classes, change enrollment maximums, or to simply inquire as to the progress of registration.

Prior to the registration dates, all students are mailed permits to register. These permits designate the time and date for the student to appear for registration. The students are scheduled by total credits earned by graduate and undergraduate level in 15 minute intervals. The number of students per 15 minute period is based on 6 students per minute. Students who have lost their permit may request a duplicate copy at the entrance to registration.

To gain admission to the registration area the student presents the permit and in turn receives a registration and receipt form. Once inside, the student completes the registration form consulting the TV monitors for closed classes, and if needed after seeking advise and counseling from administration or faculty present in the registration area. As soon as the student has completed the registration form they proceed to the terminal area. The terminal operator enters the student I. D. and verifies the validity of the student by a computer response of the student's full name. Then the terminal operator enters the desired schedule and the information is read back to the student for verification. When the terminal operator completes the registration the system automatically assesses the student's tuition and fees owed less any pre-payments or credits. The student then proceeds to the Cashier's area for payment of fees and registration is complete. The entire process can be accomplished in less than 10 minutes.

Cost Comparison of Old & New System

Besides dramatic improvements in data collection and reporting of student information, this low cost system solution offered an approximate three year pay back which represents a significant savings to the institution. In addition, staff savings included 1 Data Entry position in the Computer Center, 6 clerical positions in the Registrar's Office, and $10,000 savings a year in part-time help during registration periods. (See Figure 5)

Summary

I would like to recap now the goals of the institution and evidence the resulting solutions.

1. Improve the responsiveness of the system -
    - Students now complete registration in minutes instead of hours.
    - The data in the system is always current and available for producing a wide variety of reports on request.
    - The class rolls are available to the faculty at 8:00 a. m. following registration (first time in 87 year history of the institution).
    - Closed classes are displayed the instant they occur.
2. Reduce support costs -
    - System paid for itself in 3 years (savings exceed estimates).

3. Provide for advising during registration-
   - Preserved the informal, personal aspects of old system by continued presence of academic department advisors at the registration scene.
4. Satisfy the needs of both faculty and students-
   - Unfortunately in order to satisfy the above requirements a considerable amount of faculty time is still required, but considerably less frustrating. The following comments from faculty and students are offered:

Question:

What do you think of the new registration system?

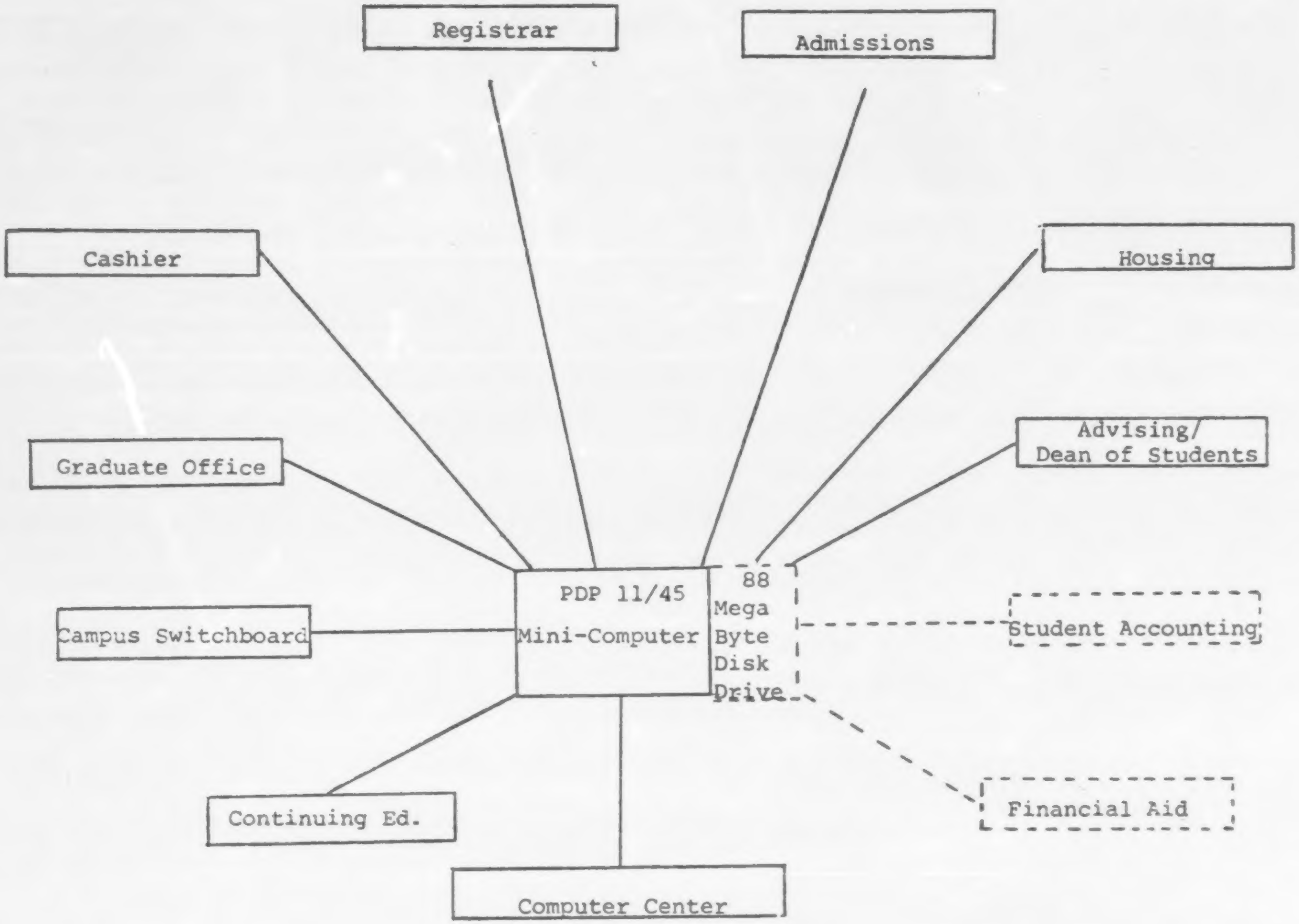
Answer:

Student: "It's a lot faster and easier, not as confusing as the old system."

Student: "It is much quicker, I like signing my name only once and not 15 times on the cards.

University Dean: "In my 17 years in higher education, spanning (4) major universities, it is the finest system I've seen.

To accomplish the goals of the institution while satisfying the needs of the systems worst critics made the entire effort a most enjoyable and rewarding experience for everyone involved.



——————— Current users

--------- Planned additions

Local interactive computing link for Student Information System.

Figure 1

Figure 2

Mini Computer Configuration

- PDP 11/45 (Digital Equipment Corporaton)
- 128 K Words Memory
- (2) 800 BPI Tape Drives
- (2) 300 LPM Printers
- (1) Card Reader
- (2) 88 Mesabyte Disk Drives
- (33) Communications Ports
    - (28) Direct Cabled
    - (4) Dial-up
- (24) VT50 CRT Terminals
- (4) VT05 CRT Terminals
- (2) LA36 Hardcopy Terminals
- Operating System: RSTS/E version 6C
  (Resource Sharing, Time Sharing/Extended)
- Program Language: Basic Plus

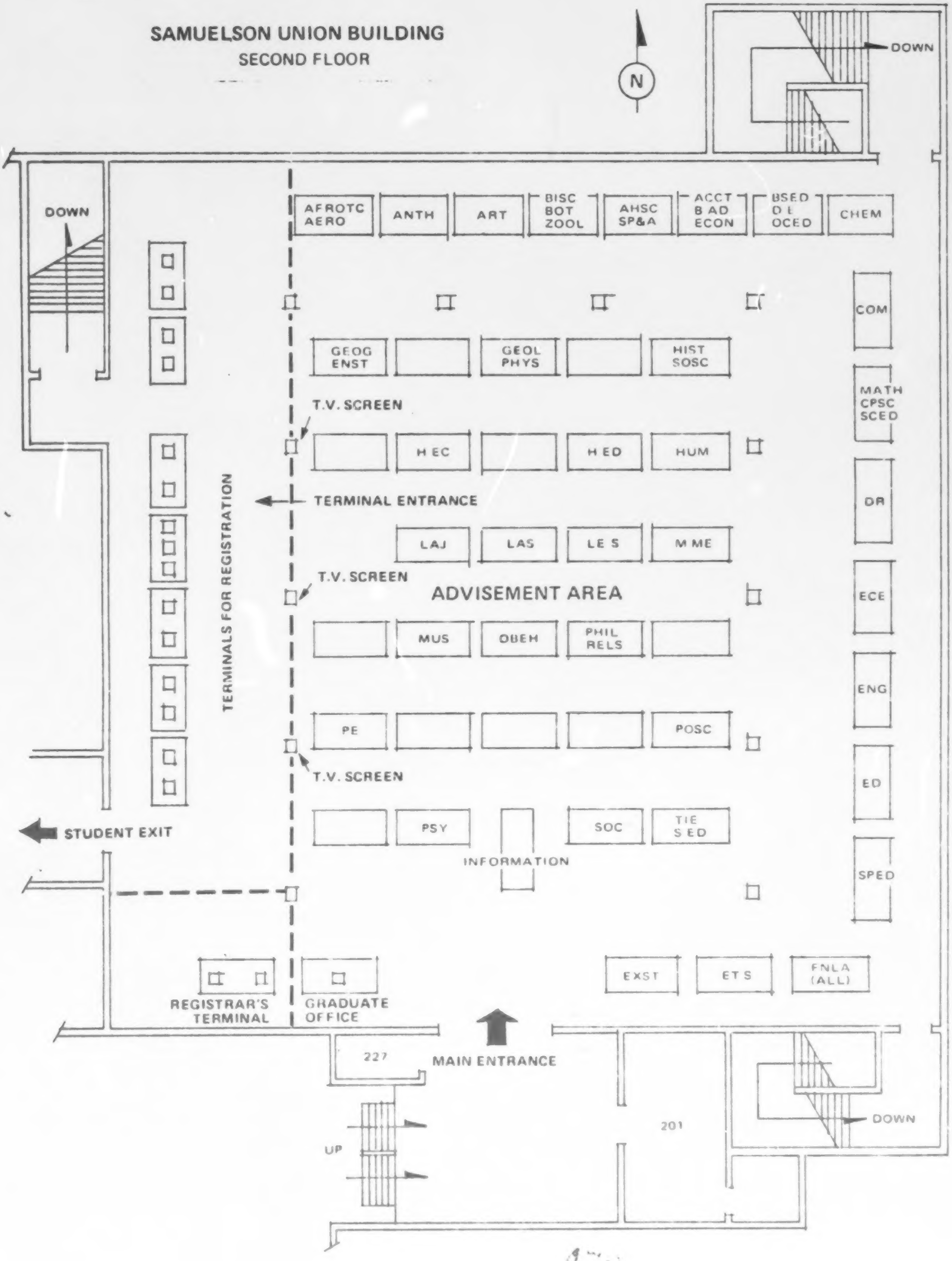
Figure 3

Command Function of Dispatch Routine

Sample Screen Display

1. Terminal operator logs into system.
   Screen Displays: COMMAND->?
2. Terminal operator chooses to display student demographic information.
   Operator response: COMMAND->? DISPLAY ■
3. Computer Responds
   Screen Display: ADMISSIONS, STUDENT, COURSE OR CLASS? ■
4. Terminal operator designates student file.
   Operator response:
   ADMISSIONS, STUDENT, COURSE OF CLASS? S
5. Computer Response
   Screen Display: ENTER STUDENT-ID->?
6. Terminal operator enters student number.
   Operator response: ENTER STUDENT-ID->? 999999999 ■
7. Demographic information is then displayed on screen.

Figure 4


SAMUELSON UNION BUILDING
SECOND FLOOR
N
DOWN
DOWN
AFROTC AERO
ANTH
ART
BISC BOT ZOOL
AHSC SP&A
ACCT B AD ECON
BSED DE OCED
CHEM
COM
MATH CPSC SCED
DR
ECE
ENG
ED
SPED
GEOG ENST
GEOL PHYS
HIST SOSC
T.V. SCREEN
H EC
H ED
HUM
TERMINAL ENTRANCE
TERMINALS FOR REGISTRATION
LAJ
LAS
LE S
M ME
T.V. SCREEN
ADVISEMENT AREA
MUS
OBEH
PHIL RELS
PE
POSC
T.V. SCREEN
STUDENT EXIT
PSY
SOC
TIE S ED
INFORMATION
EXST
ETS
FNLA (ALL)
REGISTRAR'S TERMINAL
GRADUATE OFFICE
MAIN ENTRANCE
227
201
UP
DOWN

COST COMPARISONS

	OLD SYSTEM		3-YEAR PERIOD	MINI-COMPUTER		3-YEAR PERIOD
1.	Computing Costs - 40% of lease or $50,000/year		$150,000	Purchase Price Computer	$156,000	$156,000
				Terminals	$ 35,000	$ 35,000
				Maintenance	$ 24,000/yr	$ 72,000
2.	Staff Costs (reflects only staff of known savings)					
	A. Computer Center	$ 7,000/yr	$ 21,000			0
	(1) data entry operator					
	B. Registrar's Office	$42,000/yr	$126,000			0
	(6) clerks					
	C. Part-Time Help (20)	$17,000/yr	$ 51,000		$ 7,000/yr	$ 21,000
			$348,000			$284,000

Figure 5

ON-LINE POSITION CONTROL/BUDGETING:
A TOOL FOR MANAGEMENT OF A KEY RESOURCE

Joseph E. Hayes
University of Colorado
Boulder, Colorado

ON-LINE POSITION CONTROL/BUDGETING: A TOOL FOR MANAGEMENT OF A KEY RESOURCE

Joseph E. Hayes
University of Colorado
Boulder, Colorado

Control of the personnel budget is a major concern of university administrators. Personnel and personnel-related expenditures typically account for up to 80% of the total institutional budget. The University of Colorado is a good example. The university has four campuses located in Boulder, Colorado Springs and Denver, Colorado. The four campuses have a total of 9,747.5 FTE faculty, staff and unclassified administrators. Total dollar expenditures for personnel amount to approximately $210 million out of a total annual budget of $262,134,000.

The need to maintain control of this expenditure is as critical as it is difficult to achieve. Overexpenditure of the personnel budget in these times of tight budgets can be disastrous. Under-utilization of budget allocations can leave faculty and staff extremely upset. Ideally, the personnel budgeting process will have as its goal maximization of the use of the personnel budget resource to meet the changing needs of the institution.

The time lags normally associated with the batch processing of monthly accounting and budget reporting cycles are often contributory factors in poor spending decisions. At the same time hiring decisions are frustratingly delayed until more accurate data can be made available. The result is often a proliferation of manually updated ledgers used in conjunction with batch computer printouts to keep budget data current. Faced with this problem, the University of Colorado began the development of an on-line system to provide the control required.

The Position Control System provides for monitoring of job appointments to ensure that: (1) funds are available, (2) staff appointments are made only to job classes which have been approved by the Personnel Office, and (3) faculty and staff appointments are made only to positions which have been established by the Budget Office. The Position Control System can prevent "position freezes" due to overspending, and provides accurate, timely reports of staffing patterns to institutional officers and legislative and agency committees. The Payroll/Personnel System as originally designed, did not contain this management and control capacity.

The personnel and fiscal significance of position control led to the development of the interactive system in 1977. This system and related procedures are designed to simplify the appointment process by eliminating most of the signatures formerly required on the Personnel Action Form (PAF). The system's control features will prevent the processing of requisitions for position hired and/or subsequent appointments unless the system data base contains appropriate information on the availability of funds, job class approval, and assignment of position numbers.

The major benefits of the Position Control System are threefold:

1. Accurate information, up-dated daily, such as positions vacancies, rates, and salary savings will be available to decision-makers.
2. The need for position freezes, required in the past by appointments to unbudgeted positions, will be significantly reduced. Where shortages result from external actions, the duration of position freezes will be minimized, because current, accurate position data will be available to help decision-makers direct

the campus' response.

3. The time between hiring an individual and the incorporation of appointment data into the Payroll/Personnel System will be reduced, since nearly all signatures formerly required on the PAF will be eliminated.

System Mechanics

The control function is performed in two offices; the Payroll/Personnel Office and the Budget Office.

The Payroll/Personnel Office processes all Personnel Action Forms (PAF's) for the University of Colorado at Boulder. Each PAF is checked against the on-line file for specific data depending on the action being taken. A termination, for example, requires the Payroll/Personnel Office to enter the date the position is to be vacated.

A request (requisition) to fill a vacant position or a position to be vacated also goes to the Payroll/Personnel Office where it is checked against the on-line file. This check includes verification that the position to be filled is vacant, that funds are available and the job class is correct for the position.

The Budget Office controls the input of all financial data to the on-line system. Close coordination of the Budget Office, the Payroll/Personnel Office and the operating departments is necessary and has been developed at Colorado.

The following sections present the detail system documentation including screen formats and processors:

CHAPTER I. POSITION CONTROL SYSTEM INTRODUCTION

The POSITION CONTROL SYSTEM consists of the following screens:

POSITION SYSTEM DIRECTORY
BUDGET PAGING
BUDGET UPDATE
BUDGET SUMMARY
POSITION
FUNDING SOURCE

Three files support the screens: The BUDGET FILE, the POSITION FILE and the FUNDING SOURCE FILE.

CHAPTER II. SIGN-ON, SIGN-OFF, SYSTEM ABNORMAL TERMINATION AND TRANSACTION ABNORMAL TERMINATION

SIGN-ON

The system requires an operator to perform a sign-on operation on the terminal prior to displaying any of the POSITION System screens.

The sign-on is performed as follows:
1. Depress the CLEAR key and then the RESET key.
2. Enter the following:

```
CSSN PS=XXXX,NAME=Y
```

XXXX is a four-character password which may be changed at the request of the respective user management (i.e. Budget Office); Y is a twenty-character terminal operator name which is also set up at the request of the respective management.

If the password and name are entered correctly, the message SIGN-ON IS COMPLETE will be displayed on the screen after the ENTER key is depressed.

The operator may now depress the CLEAR key and utilize the POSITION System Screens.

SIGN-OFF

To assist in maintaining the integrity and confidentiality of the POSITION System Files, the Operator is required to sign off the terminal at any time it is to be left unattended.

The sign-off is performed as follows:
1. Depress the CLEAR key and then the RESET key.
2. Enter the keyword CSSF.

If the keyword is entered successfully, the message SIGN-OFF IS COMPLETE will be displayed on the screen after the ENTER key is depressed.

SYSTEM ABNORMAL TERMINATION

There will be instances when the operating system and/or CICS will abnormally terminate, extinguishing the SYSTEM AVAILABLE indicator located on the terminal screen. The operator must follow these steps to recover:

1. Wait until the SYSTEM AVAILABLE indicator is on indicating the system is in operation and the Data Base has been recovered up to and possibly including your last transaction.

2. Perform the SIGN-ON routine.
3. If the last transaction performed was simply a screen retrieval and display, your recovery is complete at this stage.
4. If the last transaction performed was to update a record, or to add a new record to the file, it is possible that the termination was not completed.
    - 4.1 Check to see if the updated (or new) record went to file.
    - 4.2 If not, re-enter this last transaction.
    - 4.3 If it did go to file, continue with next transaction.

TRANSACTION ABNORMAL TERMINATION

There will be instances, when the system is approaching an overload condition, when a transaction will abnormally terminate. This condition can be recognized by the message TRANSACTION HAS BEEN ABNORMALLY TERMINATED appearing on the screen at the point located by the cursor. To insure the integrity of the files, the transaction causing the termination must be re-entered into the terminal.

Line 1 ____ POSITION SYSTEM DIRECTORY

Line 2 ____ PAGING SCREEN : ACCOUNT _______ - __ BCA ____ PAGE ___ LINE __
Line 3 ____ POSITION SCREEN : POSITION _____
Line 4 ____ SUMMARY SCREEN : ACCOUNT _______

Line 5 ____ CAMPUS __
Line 6 ____ YEAR ___

NOTES:

1. Types of partial keys

1.1 For all screens enter campus and year.
1.2 For POSITION SCREEN enter POSITION NUMBER
1.3 For PAGING SCREEN any one of the following combinations for the key may be used:
- ACCOUNT
- ACCOUNT, BCA
- ACCOUNT, BCA, PAGE
- ACCOUNT, BCA, PAGE, LINE

1.4 For SUMMARY SCREEN enter account (first seven digits).

CHAPTER III. DIRECTORY SCREEN

The DIRECTORY SCREEN is the focal point for the entire on-line system. Through the directory you gain access to any of the other five POSITION SYSTEM screens.

I. Obtaining the DIRECTORY SCREEN

The DIRECTORY SCREEN can be brought up on the terminal in the following ways:

A. From a blank screen type in the word POSN and depress the ENTER key.

B. From any one of the other screens, depress the PA1, PA2 or PA3 key. NOTE: It should be understood that depression of the PA1, PA2, PA3 or CLEAR keys essentially blanks out the screen and does not send any of the data found on that screen to the computer. The clear key should not be used except during sign-on or sign-off. If it is accidentally depressed you must type POSN to get back to the DIRECTORY SCREEN.

II. Using the DIRECTORY SCREEN

The DIRECTORY SCREEN allows direct access to any one of three screens depending on the fields keyed:

BUDGET PAGING SCREEN	(line 2)
POSITION SCREEN	(line 3)
BUDGET SUMMARY SCREEN	(line 4)

or indirect access to the

BUDGET UPDATE SCREEN	(line 2)
FUNDING SOURCE SCREEN	(line 3)

A. BUDGET PAGING SCREEN
A partial or full key can be entered in line 2 to view specific BCA Activity:

1. Partial keys
   - ACCOUNT
   - ACCOUNT and BCA #
   - ACCOUNT, BCA # and PAGE
2. Full key
   - ACCOUNT, BCA #, PAGE and LINE

B. POSITION SCREEN

The specific 5-digit POSITION NUMBER is entered in Line 3.

C. BUDGET SUMMARY SCREEN

The first seven digits of the ACCOUNT NUMBER are entered into Line 4.

D. BUDGET UPDATE SCREEN

Enter the ACCOUNT and BCA # into their respective fields in Line 2; enter "NEW" in the PAGE field. This tells the system new activity is going to be added to the file and that the next sequential file page control number for this BCA # is to be assigned.

NOTE: You must enter the specific file page number if you are continuing to enter to a page control previously opened.

Depress the ENTER key. The system will transfer control to the BUDGET PAGING SCREEN, displaying the data entered through the DIRECTORY SCREEN. Access to the BUDGET UPDATE SCREEN is obtained through the PAGING SCREEN.

E. FUNDING SOURCE SCREEN

Enter the appropriate 5-digit POSITION NUMBER in line 3. Depress the ENTER key. Access to the FUNDING SOURCE SCREEN is obtained through the POSITION SCREEN.

CAMPUS/YEAR

In addition to one of the above key fields, the CAMPUS (line 5) and year (line 6) must be entered. If each time through the DIRECTORY SCREEN the same CAMPUS/YEAR is being used, it need not be re-entered. If either CAMPUS or YEAR changes, the new CAMPUS and/or YEAR will have to be entered.

Depress the ENTER key to transfer control to the requested screen.

III. ERROR MESSAGES AND RECOVERY PROCEDURES

A. ERROR HAS OCCURRED - CORRECT HIGHLIGHTED FIELDS

The field(s) being highlighted have been incorrectly entered or not entered.

- All fields take numeric data only (exception is "NEW" in PAGE field of Line 2 for Adding new BCA Activity to file).
- Check for valid CAMPUS/YEAR combination.
- In entering partial keys in Line 2 they must be entered consecutively from left to right.
- Check that imbedded campus code in ACCOUNT (either line 2 or line 4) is = to explicit CAMPUS code (Line 5).

Correct by moving the cursor to the appropriate field(s), making the necessary corrections and depressing the ENTER key.

Line 1 ____ POSITION SYSTEM DIRECTORY

Line 2 ____ PAGING SCREEN : ACCOUNT _______ - __ BCA ____ PAGE ___ LINE__
Line 3 ____ POSITION SCREEN : POSITION _____
Line 4 ____ SUMMARY SCREEN : ACCOUNT _______

Line 5 ____ CAMPUS __
Line 6 ____ YEAR ___

I [illegible]S:

1. Types of partial keys

   1.1 For all screens enter campus and year.
   1.2 For POSITION SCREEN enter POSITION NUMBER
   1.3 For PAGING SCREEN any one of the following combinations for the key may be used:
   - ACCOUNT
   - ACCOUNT, BCA
   - ACCOUNT, BCA, PAGE
   - ACCOUNT, BCA, PAGE, LINE

   1.4 For SUMMARY SCREEN enter account (first seven digits).

```
Line 1 ____            BUDGET PAGING FOR CAMPUS X  YEAR XX
Line 2 ____   REQUESTED ACCOUNT  XXXXXXXX-XX  BCA XXXX PAGE XXX LINE XX  UPDATE SCREEN__
Line 3 ____    XXXXXXX-XX   BCA XXXX  C/T  X  PAGE XXX LINE XX BCA DATE XX/XX/XX ENTRY CODE XX
Line 4 ____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 5 ____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __  POSITION __
Line 6 ____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX ENTRY CODE XX
Line 7 ____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 8 ____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __  POSITION __
Line 9 ____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX  ENTRY CODE XX
Line 10____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX  POSITION XXXXX
Line 11____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __
Line 12____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX ENTRY CODE XX
Line 13____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 14____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __
Line 15____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX  ENTRY CODE XX
Line 16____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 17____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __
Line 18____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX  ENTRY CODE XX
Line 19____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 20____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __  POSITION __

Line 21____   NEXT ACCOUNT  _______-__ BCA ____ PAGE ___ LINE __
```

NOTES:

1. Keyable fields:
   - 1.1 Lines 5,8,11,14,17 and 20
     - UPDATE: Request to transfer to UPDATE SCREEN using this record as key.
     - POSITION: Request to transfer to POSITION SCREEN using this record as key.
   - 1.2 Line 21
     - NEXT ACCOUNT: Use to request next account
     - BCA : Use to request next account and specific BCA
     - PAGE : Use to request next account, specific BCA and page.
     - LINE : Use to request next account, specific BCA, page and line (full key will retrieve specific record).
2. ENTER key without any keyable fields entered through screen "PAGES" through budget file: brings up next five records on file repeating line 18 record as line 3.
3. PA1 key returns to DIRECTORY SCREEN.
4. CLEAR key returns control to CICS and displays a blank screen.

3-10-78

CHAPTER IV. BUDGET PAGING SCREEN

The BUDGET PAGING SCREEN will display up to five consecutive BCA LINE ITEMS (Account Number Sequence) using the key input on the DIRECTORY SCREEN (or the one entered via Line 21). The matching account (or the first one on file greater than that requested if there is no match) will be displayed in Lines 3-5. The key used for the request will appear in Line 2.

I. Obtaining the BUDGET PAGING SCREEN

This screen is obtained by initiating a search by account (or other partial or full key) through the DIRECTORY SCREEN as described in Chapter 3.

II. Using the BUDGET PAGING SCREEN

While the BUDGET PAGING SCREEN is a display screen only, a number of options are available to the user:

- PAGING - PAGE through the Budget File viewing up to five BCA LINE ITEMS at any one time (Account number sequence)
- CROSS TO UPDATE SCREEN - To correct any one of the displayed line items (within an OPEN PAGE CONTROL)
- CROSS TO POSITION SCREEN - To cross to the POSITION SCREEN using the POSITION NUMBER associated with any one of the five displayed line items
- ADD NEW BCA ACTIVITY - Cross to BUDGET UPDATE SCREEN to add new BCA activity to file

A. PAGING

To view the next four sequential accounts on file, depress the ENTER key. The fifth account on the current screen (Lines 18-20) will become the first account on the new screen (Lines 3-5) followed by the next four sequential accounts on file.

To skip to a new series of accounts, enter the ACCOUNT and if needed, the BCA #, PAGE and LINE into Line 21. Depress the ENTER key. The requested account will appear in Line 2 and the LINE ITEM with an equal key (or first key greater than that requested) will appear in Lines 3-5.

B. CROSS TO UPDATE SCREEN

To correct any one of the existing displayed line items, place an X in the appropriate UPDATE SCREEN field, Lines 5, 8, 11, 14, 17 or 20 and depress the ENTER key.

NOTE: The line item selected must be one within an OPEN PAGE CONTROL.

C. CROSS TO POSITION SCREEN

For any one of the displayed BCA LINE ITEMS having a position number place an X in the POSITION SCREEN ___ field and depress the ENTER key. This will retrieve the requested position record and format on the POSITION SCREEN.

D. ADD NEW BCA ACTIVITY

There are two methods by which additional activity can be added to file:

1. For an OPEN PAGE CONTROL you can key the ACCOUNT, BCA # and PAGE into Line 2 of the DIRECTORY SCREEN, depress ENTER and the key will appear in Line 2 of the PAGING SCREEN. Enter an X in the UPDATE SCREEN ___ field in Line 2 of the PAGING SCREEN, depress ENTER key and you will transfer to the UPDATE SCREEN for additional input to the specified PAGE CONTROL.

2. To open a new PAGE CONTROL to an existing BCA or a new BCA and PAGE, you must key in ACCOUNT #, BCA # and "NEW" in the page field of Line 2 of the DIRECTORY SCREEN. After depressing ENTER this key will appear in Line 2 of the PAGING SCREEN. Then by inserting an X in the UPDATE SCREEN ___ field in Line 2 of the PAGING SCREEN and depressing the ENTER key, the UPDATE SCREEN will format the ACCOUNT #, BCA # and system assigned PAGE # for adding activity to the file.

III. ERROR MESSAGES AND RECOVERY PROCEDURES

A. NEXT ACCOUNT REQUEST INVALID - CORRECT HIGHLIGHTED FIELDS

- Only numeric data is valid in the ACCOUNT, BCA #, PAGE and LINE fields (unless "NEW" is entered in PAGE field). Re-enter request and depress ENTER.

B. REQUESTED TO CROSS TO UPDATE SCREEN OR NONEXISTENT ACCOUNT

- Make certain that there is an account number displayed for the line you are attempting to use to transfer to the UPDATE SCREEN. Enter your request again.

```
Line 1 ____                         BUDGET PAGING FOR CAMPUS X  YEAR XX
Line 2 ____   REQUESTED ACCOUNT  XXXXXXXX-XX  BCA XXXX PAGE XXX LINE XX  UPDATE SCREEN__
Line 3 ____     XXXXXXX-XX     BCA XXXX  C/T  X  PAGE XXX LINE XX BCA DATE XX/XX/XX ENTRY CODE XX
Line 4 ____                    AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 5 ____                    DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __  POSITION __
Line 6 ____     XXXXXXX-XX     BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX ENTRY CODE XX
Line 7 ____                    AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 8 ____                    DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __  POSITION __
Line 9 ____     XXXXXXX-XX     BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX  ENTRY CODE XX
Line 10____                    AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX  POSITION XXXXX
Line 11____                    DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __
Line 12____     XXXXXXX-XX     BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX ENTRY CODE XX
Line 13____                    AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 14____                    DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __
Line 15____     XXXXXXX-XX     BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX  ENTRY CODE XX
Line 16____                    AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 17____                    DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __
Line 18____     XXXXXXX-XX     BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX  ENTRY CODE XX
Line 19____                    AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 20____                    DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __

Line 21____   NEXT ACCOUNT     ________-__ BCA ____ PAGE ___ LINE __
```

NOTES:

1. Keyable fields:
   - 1.1 Lines 5,8,11,14,17 and 20
     - UPDATE: Request to transfer to UPDATE SCREEN using this record as key.
     - POSITION: Request to transfer to POSITION SCREEN using this record as key.
   - 1.2 Line 21
     - NEXT ACCOUNT: Use to request next account
     - BCA : Use to request next account and specific BCA
     - PAGE : Use to request next account, specific BCA and page.
     - LINE : Use to request next account, specific BCA, page and line (full key will retrieve specific record).
2. ENTER key without any keyable fields entered through screen "PAGES" through budget file: brings up next five records on file repeating line 18 record as line 3.
3. PA1 key returns to DIRECTORY SCREEN.
4. CLEAR key returns control to CICS and displays a blank screen.

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```
Line 1 ____                    BUDGET PAGING FOR CAMPUS X  YEAR XX
Line 2 ____   REQUESTED ACCOUNT  XXXXXXXX-XX  BCA XXXX PAGE XXX LINE XX  UPDATE SCREEN__
Line 3 ____    XXXXXXX-XX   BCA XXXX  C/T  X  PAGE XXX LINE XX BCA DATE XX/XX/XX ENTRY CODE XX
Line 4 ____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 5 ____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __  POSITION __
Line 6 ____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX ENTRY CODE XX
Line 7 ____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 8 ____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __  POSITION __
Line 9 ____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX  ENTRY CODE XX
Line 10____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX  POSITION XXXXX
Line 11____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __
Line 12____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX ENTRY CODE XX
Line 13____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 14____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __
Line 15____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX  ENTRY CODE XX
Line 16____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 17____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __
Line 18____    XXXXXXX-XX   BCA XXXX C/T X PAGE XXX LINE XX BCA DATE XX/XX/XX  ENTRY CODE XX
Line 19____                 AMOUNT XXXXXXXX± FTE XXX.XX± JOBCLASS XXXXXX POSITION XXXXX
Line 20____                 DESC XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  UPDATE __   POSITION __

Line 21____   NEXT ACCOUNT  ________-__  BCA ____  PAGE ___  LINE __
```

NOTES:

1. Keyable fields:
   - 1.1 Lines 5,8,11,14,17 and 20 UPDATE: Request to transfer to UPDATE SCREEN using this record as key.
     POSITION: Request to transfer to POSITION SCREEN using this record as key.
   - 1.2 Line 21 NEXT ACCOUNT: Use to request next account
     BCA : Use to request next account and specific BCA
     PAGE : Use to request next account, specific BCA and page.
     LINE : Use to request next account, specific BCA, page and line (full key will retrieve specific record).
2. ENTER key without any keyable fields entered through screen "PAGES" through budget file: brings up next five records on file repeating line 18 record as line 3.
3. PA1 key returns to DIRECTORY SCREEN.
4. CLEAR key returns control to CICS and displays a blank screen.

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C. CONTROL CLOSED ON REQUESTED BCA # AND PAGE - CANNOT BE UPDATED

- The PAGE CONTROL for this line item has been closed. In order to change the AMOUNT and/or FTE Fields for this account, you must open a new PAGE CONTROL. See ADD NEW BCA ACTIVITY under section II USING THE BUDGET PAGING SCREEN.

D. BCA # AND PAGE # MUST BOTH BE PRESENT TO CROSS TO UPDATE SCREEN

- In order to cross to the UPDATE SCREEN the BCA # and PAGE # must both be entered (either an existing PAGE # or "NEW"). Re-enter the requested ACCOUNT #, BCA # and PAGE into Line 21 and depress ENTER.

```
Line 1 ____                              BUDGET UPDATE
Line 2 ____     BCA XXXX  CAMPUS X     YEAR XX     PREV LINE XX
Line 3 ____     BCA DATE ________

                                  ADD        DEDUCT                               ADD    DEDUCT
Line 4 ____     YTD BCA CONTROL     $ XXXXXXXX  XXXXXXXX  YTD BCA CONTROL FTE    XXXXX  XXXXX
Line 5 _____    CURR PAGE CONTROL $ ________  ________  CURR PAGE CONTROL FTE  _____  _____
Line 6 ____     CURR CUM LINE       $ XXXXXXXX XXXXXXXX  CURR CUM LINE FTE      XXXXX  XXXXX

Line 7 ____     PAGE XXX LINE __  ACCOUNT ______-__
Line 8 ____     ENTRY CODE __  DESCRIP________ __________ ________ POSITION _____
Line 9 ____     JOBCLASS _____  AMOUNT ________+ FTE _____ ± CORRECTION _

Line 10 ____    CLOSE CONTROL FOR BCA ____  PAGE __
Line 11 ____    PAGING SCREEN __
```

NOTES:

1. Keyable fields: Indicated by underlined positions in lines 3,5, 7, 8, 9, 10 and 11.

2. PA1 key: Returns to DIRECTORY SCREEN

3. CLEAR key: Returns control to CICS and displays a blank screen.
4. ENTER key:
   - 4.1 For a new line item being entered:
     - Line 2 - PREV LINE will be updated with line 7 entry
     - Line 3 - As is. Exception: The first update request for this BCA and PAGE will require the user to enter BCA DATE.
     - Line 4 - Will reflect YTD balance for this BCA (all closed pages within this BCA).
     - Line 5 - Displays page control as initially entered or modified.
     - Line 6 - Updated with respective amounts entered in line 9 for each entry.
     - Lines 7 - 9 Blanked for next entry.
   - 4.2 Line 10 - After requesting that current page control be "CLOSED" for this BCA, returns to DIRECTORY SCREEN.
   - 4.3 Line 11 - Request to cross to PAGING SCREEN using current record as key.

CHAPTER V. BUDGET UPDATE SCREEN

The UPDATE SCREEN is the entry point for all budget activity.

I. Obtaining the BUDGET UPDATE SCREEN

The UPDATE SCREEN is obtained in three different ways:

A. Through the DIRECTORY SCREEN

1. To open a new PAGE CONTROL to an existing BCA or a new BCA and PAGE, you must key in ACCOUNT #, BCA # and "NEW" in the page field of Line 2 of the DIRECTORY SCREEN. After depressing ENTER, this key will appear in Line 2 of the PAGING SCREEN. Then by inserting an X in the UPDATE SCREEN _ field in Line 2 of the PAGING SCREEN and depressing the ENTER key, the ACCOUNT #, BCA # and system assigned PAGE # will be formatted on the UPDATE SCREEN for adding activity to the file.

2. For an OPEN PAGE CONTROL you can key the ACCOUNT #, BCA # and PAGE into Line 2 of the DIRECTORY SCREEN, depress ENTER and the key will appear in Line 2 of the PAGING SCREEN. Enter an X in the UPDATE SCREEN _ field of Line 2 of the PAGING SCREEN. Depress ENTER key and you will transfer to the UPDATE SCREEN for additional input to the specified PAGE CONTROL.

B. From the PAGING SCREEN

1. After requesting an account through the DIRECTORY SCREEN and finding it displayed on the PAGING SCREEN, you may request that the LINE ITEM be transferred to the UPDATE SCREEN for corrections. To correct any one of the displayed LINE ITEMS, place an X in the appropriate UPDATE SCREEN _ field, Lines 5, 8, 11, 14, 17 or 20 and depress the ENTER key.

NOTE: The LINE ITEM selected must be one within an OPEN PAGE CONTROL.

II. Using the BUDGET UPDATE SCREEN

A. To "ADD" BCA ACTIVITY TO THE FILE:

1. If this is a new BCA or a new FILE PAGE to an existing BCA, the BCA DATE (MMDDYY) must be entered in line 3.

   In addition, the controls must be entered in line 5, "CURR PAGE CONTROL".

2. For each LINE ITEM, the following fields must be entered:
   Line 7 - LINE; ACCOUNT
   Line 8 - ENTRY CODE; DESCRIP; POSITION
   Line 9 - JOBCLASS; AMOUNT; AMOUNT SIGN;
   FTE; FTE SIGN

Explanation of fields:

- LINE - taken from SOURCE DOCUMENT to provide audit trail (numeric 01 - 99)
- ACCOUNT - Account keyed will be verified to the current CHART OF ACCOUNTS
- ENTRY CODE - alphanumeric

	CONTINUING	TEMPORARY
BASE	20	
REVISE	21	24
ANNIV	2A	2B
RECLASS	2C	
REGRADE	2D	

- DESCRIP - taken from SOURCE DOCUMENT (30 character limit)
- POSITION - data entered through UPDATE SCREEN will also udpate the POSITION RECORD and corresponding FUNDING SOURCE RECORD
- JOBCLASS - jobclass keyed will be verified to a JOBCLASS TABLE for valid number. The latest jobclass entered for a position is the one showing on the POSITION SCREEN.
- AMOUNT - if applicable, enter the amount as shown on SOURCE DOCUMENT beginning in the first keyable position of eight-place field. The system will right justify the amount entered.
- AMOUNT SIGN - if AMOUNT entered is negative, you must enter minus sign; the default is positive(+).
- FTE - if applicable, enter the FTE as shown on SOURCE DOCUMENT beginning in the first keyable position of five-place field.
  NOTE: FTE IS A 2-DECIMAL POSITION FIELD XXX.XX (i.e. .01 would be entered 01; 1.00 would be entered 100)
- FTE SIGN - if FTE entered is negative, you must enter minus sign; the default is positive(+).

After you have scanned your entry to the screen for correctness, depress the ENTER key.

REMEMBER: until you ENTER, nothing you have keyed has gone into the system and anything can be corrected. After you depress ENTER key and your transaction is accepted, only the AMOUNT, AMOUNT SIGN, FTE and FTE SIGN fields can be changed.

The BUDGET UPDATE SCREEN will be returned to you with the respective total fields updated in Line 6, "CURR CUM LINE". LINES 7, 8 and 9 will be ready for your next LINE ITEM entry.

B. TO CHANGE AN "EXISTING" BCA LINE ITEM

The only changeable fields are:

AMOUNT - if you change amount you must enter the appropriate sign, - or +

```
Line 1  ____                         BUDGET UPDATE
Line 2  ____   BCA XXXX  CAMPUS X   YEAR XX    PREV LINE XX
Line 3  ____   BCA DATE ______

                                   ADD       DEDUCT                             ADD    DEDUCT
Line 4  ____   YTD BCA CONTROL   $ XXXXXXXX  XXXXXXXX  YTD BCA CONTROL FTE     XXXXX  XXXXX
Line 5  ____   CURR PAGE CONTROL $ ________  ________  CURR PAGE CONTROL FTE   _____  _____
Line 6  ____   CURR CUM LINE     $ XXXXXXXX  XXXXXXXX  CURR CUM LINE FTE       XXXXX  XXXXX

Line 7  ____   PAGE XXX LINE __  ACCOUNT ______-__
Line 8  ____   ENTRY CODE __  DESCRIP________  __________  _________  POSITION _____
Line 9  ____   JOBCLASS _____  AMOUNT ______+ FTE _____+ CORRECTION _

Line 10 ____   CLOSE CONTROL FOR BCA ____ PAGE ___
Line 11 ____   PAGING SCREEN __
```

NOTES:

1. Keyable fields: Indicated by underlined positions in lines 3,5, 7, 8, 9, 10 and 11.
2. PA1 key: Returns to DIRECTORY SCREEN
3. CLEAR key: Returns control to CICS and displays a blank screen.
4. ENTER key:
   - 4.1 For a new line item being entered:
     - Line 2 - PREV LINE will be updated with line 7 entry
     - Line 3 - As is. Exception: The first update request for this BCA and PAGE will require the user to enter BCA DATE.
     - Line 4 - Will reflect YTD balance for this BCA (all closed pages within this BCA).
     - Line 5 - Displays page control as initially entered or modified.
     - Line 6 - Updated with respective amounts entered in line 9 for each entry.
     - Lines 7 - 9 Blanked for next entry.
   - 4.2 Line 10 - After requesting that current page control be "CLOSED" for this BCA, returns to DIRECTORY SCREEN.
   - 4.3 Line 11 - Request to cross to PAGING SCREEN using current record as key.

```
Line 1 ____                           BUDGET UPDATE
Line 2 ____   BCA XXXX  CAMPUS X    YEAR XX    PREV LINE XX
Line 3 ____   BCA DATE ________

                                  ADD        DEDUCT                               ADD     DEDUCT
Line 4 ____   YTD BCA CONTROL    $ XXXXXXXX  XXXXXXXX  YTD BCA CONTROL FTE     XXXXX   XXXXX
Line 5 _____  CURR PAGE CONTROL  $ ________  ________  CURR PAGE CONTROL FTE   _____   _____
Line 6 ____   CURR CUM LINE      $ XXXXXXXX XXXXXXXX   CURR CUM LINE FTE       XXXXX   XXXXX

Line 7 ____   PAGE XXX LINE __  ACCOUNT ______-__
Line 8 ____   ENTRY CODE __  DESCRIP_________ __________ _________ POSITION _____
Line 9 ____   JOBCLASS _____  AMOUNT ________+ FTE _____ ± CORRECTION _

Line 10 ____  CLOSE CONTROL FOR BCA ____  PAGE __
Line 11 ____  PAGING SCREEN _
```

NOTES:

1. Keyable fields: Indicated by underlined positions in lines 3,5, 7, 8, 9, 10 and 11.

2. PA1 key: Returns to DIRECTORY SCREEN

3. CLEAR key: Returns control to CICS and displays a blank screen.
4. ENTER key:
   - 4.1 For a new line item being entered:
     - Line 2 - PREV LINE will be updated with line 7 entry
     - Line 3 - As is. Exception: The first update request for this BCA and PAGE will require the user to enter BCA DATE.
     - Line 4 - Will reflect YTD balance for this BCA (all closed pages within this BCA)
     - Line 5 - Displays page control as initially entered or modified.
     - Line 6 - Updated with respective amounts entered in line 9 for each entry.
     - Lines 7 - 9 Blanked for next entry.
   - 4.2 Line 10 - After requesting that current page control be "CLOSED" for this BCA, returns to DIRECTORY SCREEN.
   - 4.3 Line 11 - Request to cross to PAGING SCREEN using current record as key.

AMOUNT SIGN -
FTE - if you change FTE, you must enter the appropriate sign, - or +
FTE SIGN -

Change the appropriate field to appear as it does on the SOURCE DOCUMENT. Enter correct figure beginning in the first keyable position; you MUST depress EOF key to clear remainder of field of previous data, then SKIP to appropriate SIGN FIELD and enter sign.

Place an X in the CORRECTION field in Line 9 and depress the ENTER key. The BUDGET PAGING SCREEN will be returned to you displaying the record as changed.

C. TO CHANGE THE "PAGE CONTROLS"

1. Enter the correct AMOUNT or FTE in the respective field(s), beginning in the first keyable position; you MUST depress EOF key to clear remainder of field of previous data.

2. You MUST place an "X" in the CORRECTION field in Line 9.

Depress the ENTER key. The changed control will be returned to you on the UPDATE SCREEN.

D. To CLOSE a PAGE which is "IN CONTROL"

When the message

"BCA NOW IN BALANCE TO CONTROL: WILL ACCEPT CLOSE REQUEST"

appears at the bottom of your screen, the PAGE should be formally closed. This is done by entering the BCA # and PAGE # in the respective fields in Line 10, and depressing ENTER. You have now created what is known as a "CLOSED PAGE CONTROL" for this BCA # and PAGE. This prevents any of the transactions which were entered under this BCA #/ PAGE from being altered. You will be returned to the DIRECTORY SCREEN for your next action.

E. To transfer back to the PAGING SCREEN

1. The ACCOUNT NUMBER must be present in Line 7.

2. Place an X in the PAGING SCREEN _ field in Line 11.

Depress ENTER. The LINE ITEM with the matching ACCOUNT #, BCA # and PAGE # will be displayed on the PAGING SCREEN.

III. ERROR MESSAGES AND RECOVERY PROCEDURES

A. ERROR HAS OCCURRED - CORRECT HIGHLIGHTED FIELDS

The field(s) being highlighted have either been incorrectly entered or not entered at all.

- **All** fields except the following accept numeric data only: ENTRY CODE, DESCRIP, CORRECTION and PAGING SCREEN.

- If this is a new FILE PAGE, the PAGE CONTROLS must be entered in Line 5 "CURR PAGE CONTROL". These controls MUST be entered at the same time the first detail line is entered into Lines 7, 8 and 9.

B. INVALID LINE NUMBER - ENTER CORRECTION

The line number entered in Line 7 is less than the previous line number, which is displayed in Line 2, PREV LINE. You must always enter the next greatest number.

C. RECORD REQUESTED FOR UPDATE NOT ON FILE

You have indicated by placing an X in the CORRECTION field that this record is an existing one on the file which you now want to correct. No such record exists.

Check your ACCOUNT and BCA numbers.

D. CLOSE REQUEST FOR INVALID BCA AND/OR PAGE

The BCA and/or PAGE numbers you have entered in Line 10 are not the same as the BCA and/or PAGE displayed in Lines 2 and 7, respectively.

CORRECT by moving the cursor to the appropriate field(s), making the necessary corrections and depressing the ENTER key.

```
Line 1 ____                              BUDGET UPDATE
Line 2 ____   BCA XXXX  CAMPUS X     YEAR XX     PREV LINE XX
Line 3 ____   BCA DATE _______

                                  ADD        DEDUCT                             ADD     DEDUCT
Line 4 ____   YTD BCA CONTROL   $ XXXXXXXX  XXXXXXXX  YTD BCA CONTROL FTE     XXXXX   XXXXX
Line 5 _____  CURR PAGE CONTROL $ _______   ________  CURR PAGE CONTROL FTE   _____   ______
Line 6 ____   CURR CUM LINE     $ XXXXXXXX XXXXXXXX   CURR CUM LINE FTE       XXXXX   XXXXX

Line 7 ____   PAGE XXX LINE __  ACCOUNT _______-__
Line 8 ____   ENTRY CODE __  DESCRIP_________ __________ ________ POSITION _____
Line 9 ____   JOBCLASS _____  AMOUNT ________+ FTE _____+ CORRECTION _

Line 10 ____  CLOSE CONTROL FOR BCA ____  PAGE ___
Line 11 ____  PAGING SCREEN __
```

NOTES:

1. Keyable fields: Indicated by underlined positions in lines 3,5, 7, 8, 9, 10 and 11.

2. PA1 key: Returns to DIRECTORY SCREEN

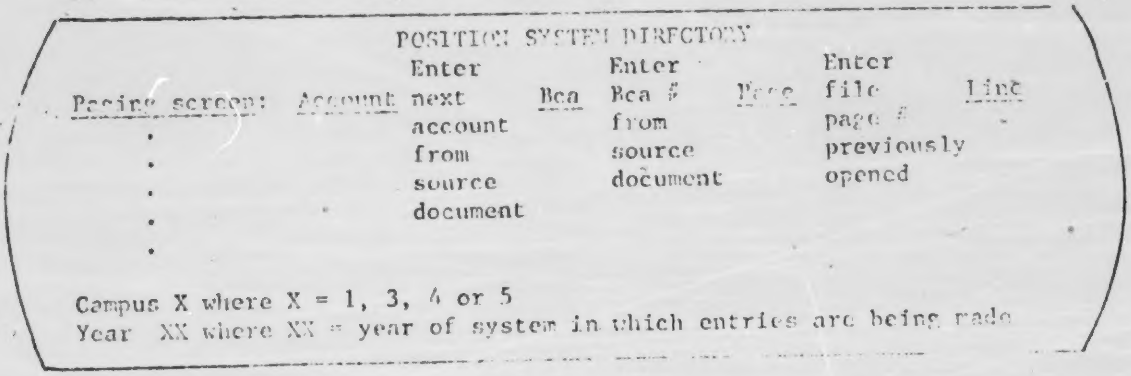
3. CLEAR key: Returns control to CICS and displays a blank screen.
4. ENTER key:
   - 4.1 For a new line item being entered:
     - Line 2 - PREV LINE will be updated with line 7 entry
     - Line 3 - As is. Exception: The first update request for this BCA and PAGE will require the user to enter BCA DATE.
     - Line 4 - Will reflect YTD balance for this BCA (all closed pages within this BCA).
     - Line 5 - Displays page control as initially entered or modified.
     - Line 6 - Updated with respective amounts entered in line 9 for each entry.
     - Lines 7 - 9 Blanked for next entry.
   - 4.2 Line 10 - After requesting that current page control be "CLOSED" for this BCA, returns to DIRECTORY SCREEN.
   - 4.3 Line 11 - Request to cross to PAGING SCREEN using current record as key.

IF YOU NEED TO INTERRUPT ENTERING TO A FILE PAGE ALREADY OPENED BUT NOT IN BALANCE OR NOT COMPLETED:

1. Complete the line item currently being entered and make a note on the source document of this last line entered;
2. Depress the CLEAR key and then the RESET key;
3. Sign off.

When you are ready to commence entering to the system:

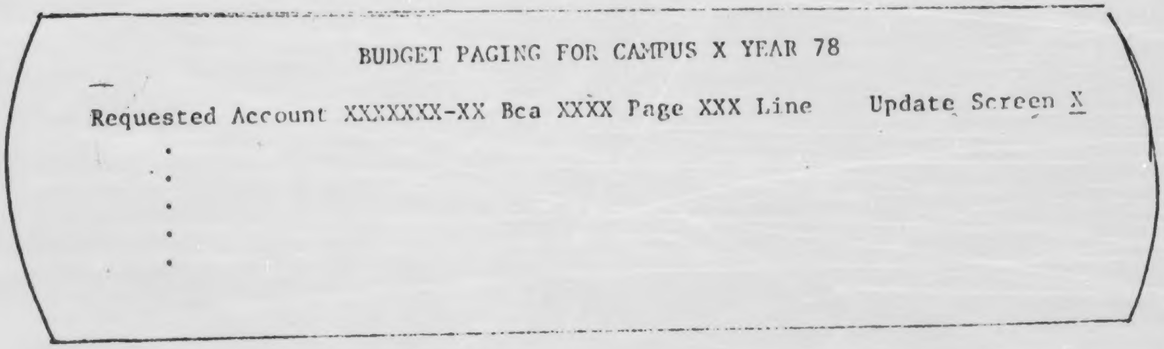
1. Sign on;
2. Bring up the Position Directory Screen;
3. Enter fields indicated below:



```
                    POSITION SYSTEM DIRECTORY
                          Enter               Enter                  Enter
Paging screen:   Account  next      Bca       Bca #        Page      file         Line
      .                   account             from                   page #
      .                   from                source                 previously
      .                   source              document               opened
      .                   document
      .

Campus X where X = 1, 3, 4 or 5
Year  XX where XX = year of system in which entries are being made
```

4. Depress the ENTER key to transfer to the Paging Screen.
5. Enter an X as indicated below and depress the ENTER key to transfer to the Budget Update Screen:



```
              BUDGET PAGING FOR CAMPUS X YEAR 78
—
Requested Account XXXXXXX-XX Bca XXXX Page XXX Line     Update Screen X
      .
      .
      .
      .
      .
```

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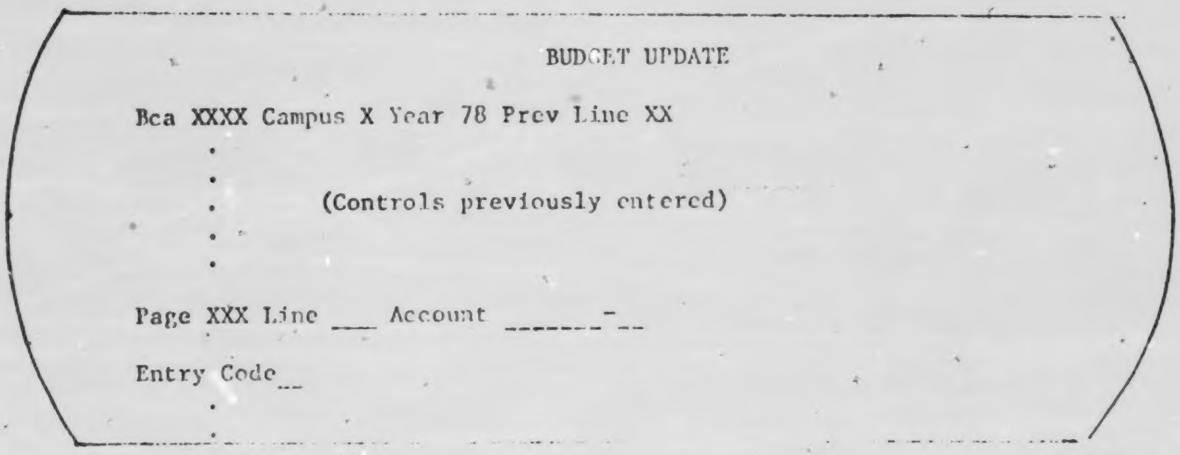
Interruption (cont)

6. Continue entering remaining line items from source document; The cursor will be positioned under the LINE field for you to enter the line # with which you are continuing (PREV LINE field on line 2 of screen will tell you which line # you last entered):



```
                    BUDGET UPDATE

Bca XXXX Campus X Year 78 Prev Line XX
      .
      .
      .        (Controls previously entered)
      .
      .

Page XXX Line ___ Account _______-__

Entry Code__
      .
      .
```

7. When FILE PAGE CONTROL is in control, close Bca and Page.

```
Line  1 ____              BUDGET SUMMARY:  ACCOUNT  XXXXXXX
Line  2 ____   BUDGET POOL         CURRENT BUDGET                         AS OF MM/DD

Line  3 ____       XX       TOTAL  $ XXXXXXXX± FTE   XXX.XX±  EXPEND   $ XXXXXXXX± FTE XXX.XX±
Line  4 ____                CONT   $ XXXXXXXX± FTE   XXX.XX±  ENCUMB   $ XXXXXXXX± FTE XXX.XX±
Line  5                     TEMP   $ XXXXXXXX- FTE   XXX.XX-  BALANCE  $ XXXXXXXX- FTE XXX.XX-

Line  6 ____       XX       TOTAL  $ XXXXXXXX± FTE   XXX.XX±  EXPEND   $ XXXXXXXX± FTE XXX.XX±
Line  7 ____                CONT   $ XXXXXXXX± FTE   XXX.XX±  ENCUMB   $ XXXXXXXX± FTE XXX.XX±
Line  8 ____                TEMP   $ XXXXXXXX- FTE   XXX.XX-  BALANCE  $ XXXXXXXX- FTE XXX.XX-

Line  9 ____       XX       TOTAL  $ XXXXXXXX± FTE   XXX.XX±  EXPEND   $ XXXXXXXX± FTE XXX.XX±
Line 10 ____                CONT   $ XXXXXXXX± FTE   XXX.XX±  ENCUMB   $ XXXXXXXX± FTE XXX.XX±
Line 11 ____                TEMP   $ XXXXXXXX- FTE   XXX.XX-  BALANCE  $ XXXXXXXX- FTE XXX.XX-

Line 12 ____       XX       TOTAL  $ XXXXXXXX± FTE   XXX.XX±  EXPEND   $ XXXXXXXX± FTE XXX.XX±
Line 13 ____                CONT   $ XXXXXXXX± FTE   XXX.XX±  ENCUM    $ XXXXXXXX± FTE XXX.XX±
Line 14 ____                TEMP   $ XXXXXXXX- FTE   XXX.XX-  BALANCE  $ XXXXXXXX- FTE XXX.XX-

Line 15 ____       XX       TOTAL  $ XXXXXXXX± FTE   XXX.XX±  EXPEND   $ XXXXXXXX± FTE XXX.XX±
Line 16 ____                CONT   $ XXXXXXXX± FTE   XXX.XX±  ENCUMB   $ XXXXXXXX± FTE XXX.XX±
Line 17 ____                TEMP   $ XXXXXXXX- FTE   XXX.XX-  BALANCE  $ XXXXXXXX- FTE XXX.XX-
```

NOTES:

This is a display screen only. After all budget pools for requested account have been displayed, depressing PA1 key will return control to the DIRECTORY SCREEN.

CHAPTER VI. BUDGET SUMMARY SCREEN

The BUDGET SUMMARY SCREEN will display the following budget information for the requested account, summarized to the BUDGET POOL level:

TOTAL BUDGET, CONT BUDGET, TEMP BUDGET, EXPENDITURES, ENCUMBRANCES and BALANCE.

I. Obtaining the BUDGET SUMMARY SCREEN

This screen is obtained by requesting an ACCOUNT through the DIRECTORY SCREEN using the SUMMARY SCREEN ___ key field, Line 4.

II. Using the BUDGET SUMMARY SCREEN

This is an inquiry only screen. The PA1 key is used to return the DIRECTORY SCREEN after you have finished viewing the totals.

III. ERROR MESSAGES AND RECOVERY PROCEDURES

A. NO CORRESPONDING ACCOUNT ON FILE

The REQUESTED ACCOUNT does not exist. Depress the PA1 key and return to the DIRECTORY SCREEN.

```
Line 1   ____                POSITION    XXXXX CAMPUS  X    YEAR XX
Line 2.  ____ NAME XXXXXXXXXXXXXXXXXXXXX  SOC SEC XXXXXXXXX  POS STATUS X  ANNIV  XX
Line 3   ____ BUDGET STATUS X OPTION CODE X PG XX STEP X POS TYPE X JOBCLASS XXXXX

Line 4   ____ BASE BUDGET $ XXXXXXXX±  FTE XXX.XX-

Line 5   ____                  CONTINUING          TEMPORARY
                              $         FTE        $        FTE         EXPENDITURES BY MONTH
Line 6   ____ ANNIV           XXXXXXXX±           XXXXXXXX±            JUL XXXXX.XX± JAN XXXXX.XX±
Line 7   ____ REGRADE         XXXXXXXX±                                AUG XXXXX.XX± FEB XXXXX.XX±
Line 8   ____ RECLASS        -XXXXXXXX±                                SEP XXXXX.XX± MAR XXXXX.XX±
Line 9   ____ REVISION        XXXXXXXX± XXX.XX±  XXXXXXXX± XXX.XX±   OCT XXXXX.XX± APR XXXXX.XX±
Line 10______ PROF SAL INC    XXXXXXXX±           XXXXXXXX±            NOV XXXXX.XX± MAY XXXXX.XX±
Line 11  ____    TOTAL...     XXXXXXXX± XXX.XX±  XXXXXXXX± XXX.XX±   DEC XXXXX.XX± JUN XXXXX.XX±

Line 12______ CURR BUDGET $XXXXXXXX± FTE XXX.XX± EXP TO DATE $XXXXXXXX.XX± FTE XXX.XX±

Line 13  ____ FACULTY DEMOGRAPHIC DATA : TENURE X  ROST X APPT NO X APPT END DATE XX
Line 14  ____                            GUAR SUMMER X  APPT TYPE X  RETIREMENT DATE XX

Line 15  ____ NEXT POSITION ____      NUM FUNDING SOURCES XX   FUNDING SOURCE SCREEN__
```

NOTES:

1. Keyable Fields:
   (1) NAME: employee's name, or VACANT, or employee's name and termination date T:MM/[illegible]Y
   (2) SOC SEC: employee's Social Security number
   (3) POS STATUS:A=active; L=leave without pay; P=leave with pay or partial pay;T=terminated
   (4) ANNIV: month of anniversary
   (5) BUDGET STATUS: C = continuing position T = temporary position
   (6) OPTION CODE: refinement of jobclass (related to skill levels)
   (7) PG : paygrade of position
   (8) STEP: step of employee
   (9) FACULTY DEMOGRAPHIC DATA: all fields
   (10) NEXT POSITION: request another Position record (same campus/year)
   (11) FUNDING SOURCE SCREEN: request to cross to FUNDING SOURCE SCREEN

2. PA1 key returns to DIRECTORY SCREEN

3-10-78

CHAPTER VII. POSITION SCREEN

The POSITION SCREEN displays a requested POSITION RECORD.

I. Obtaining the POSITION SCREEN

This screen is obtained by requesting the POSITION on the DIRECTORY SCREEN, using the POSITION key field on Line 3, or by requesting to transfer from the BUDGET PAGING SCREEN to the POSITION SCREEN.

II. Using the POSITION SCREEN

UPDATE

A. The following fields are updatable via the screen:

1. NAME - alphanumeric
2. SOC SEC - numeric
3. POS STATUS - alphanumeric
4. ANNIV - numeric
5. BUDGET STATUS - alphanumeric
6. OPTION CODE - alphanumeric
7. PG - numeric
8. STEP - numeric

In addition, the FACULTY DEMOGRAPHIC DATA elements are also updatable through the screen:

1. TENURE - alphanumeric
2. ROST - alphanumeric
3. APPT NO - numeric
4. APPT END DATE - alphanumeric
5. GUAR SUMMER - alphanumeric
6. APPT TYPE - numeric
7. RETIREMENT DATE- numeric

Enter data from the PAF (new or change) into any or all of the above fields and depress the ENTER key. The record will be displayed as updated.

INQUIRY

Two options are available from the POSITION SCREEN:

1. The next POSITION you want to display can be requested by entering that POSITION NUMBER in the NEXT POSITION ___ field on Line 15 and depressing the ENTER key;
2. By placing an X in the FUNDING SOURCE SCREEN ___field in Line 15 and depressing the ENTER key, the FUNDING SOURCE SCREEN will be displayed.

To return to the DIRECTORY SCREEN, depress the PA1 key.

III. ERROR MESSAGES AND RECOVERY PROCEDURES

A. ERROR HAS OCCURRED - CORRECT HIGHLIGHTED FIELDS

The field(s) being highlighted have been incorrectly entered:

- Data entered in field does not meet type specifications (i.e., numeric only)

Correct by moving the cursor to the appropriate field(s), making the necessary corrections and depressing the ENTER key.

B. REQUESTED POSITION RECORD NOT ON FILE

There is no matching POSITION RECORD on file for the number requested. To request another POSITION, key the next number in the NEXT POSITION ___ field in Line 15 and depress the ENTER key.

```
Line 1  ____              POSITION     XXXXX CAMPUS  X     YEAR XX
Line 2  ____ NAME XXXXXXXXXXXXXXXXXXX  SOC SEC XXXXXXXXX  POS STATUS X  ANNIV  XX
Line 3  ____ BUDGET STATUS X OPTION CODE X PG XX STEP X POS TYPE X JOBCLASS XXXXX

Line 4  ____ BASE BUDGET $ XXXXXXXX±  FTE XXX.XX±

Line 5  ____                CONTINUING           TEMPORARY
                            $          FTE       $         FTE       EXPENDITURES BY MONTH
Line 6  ____ ANNIV          XXXXXXXX±            XXXXXXXX±           JUL XXXXX.XX± JAN XXXXX.XX±
Line 7  ____ REGRADE        XXXXXXXX±                                AUG XXXXX.XX± FEB XXXXX.XX±
Line 8  ____ RECLASS        XXXXXXXX±                                SEP XXXXX.XX± MAR XXXXX.XX±
Line 9  ____ REVISION       XXXXXXXX± XXX.XX±  XXXXXXXX± XXX.XX±     OCT XXXXX.XX± APR XXXXX.XX±
Line 10 ____ PROF SAL INC   XXXXXXXX±          XXXXXXXX±            NOV XXXXX.XX± MAY XXXXX.XX±
Line 11 ____    TOTAL...    XXXXXXXX± XXX.XX±  XXXXXXXX± XXX.XX±     DEC XXXXX.XX± JUN XXXXX.XX±

Line 12 ____ CURR BUDGET $XXXXXXXX± FTE XXX.XX± EXP TO DATE $XXXXXXXX.XX± FTE XXX.XX±

Line 13 ____ FACULTY DEMOGRAPHIC DATA : TENURE X  ROST X APPT NO X APPT END DATE XX
Line 14 ____                            GUAR SUMMER X  APPT TYPE X  RETIREMENT DATE XX

Line 15 ____ NEXT POSITION ____      NUM FUNDING SOURCES XX   FUNDING SOURCE SCREEN__
```

NOTES:

1. Keyable Fields:
   - (1) NAME: employee's name, or VACANT, or employee's name and termination date T:MM/DD/YY
   - (2) SOC SEC: employee's Social Security number
   - (3) POS STATUS:A=active; L=leave without pay; P=leave with pay or partial pay;T=terminated
   - (4) ANNIV: month of anniversary
   - (5) BUDGET STATUS: C = continuing position T = temporary position
   - (6) OPTION CODE: refinement of jobclass (related to skill levels)
   - (7) PG : paygrade of position
   - (8) STEP: step of employee
   - (9) FACULTY DEMOGRAPHIC DATA: all fields
   - (10) NEXT POSITION: request another Position record (same campus/year)
   - (11) FUNDING SOURCE SCREEN: request to cross to FUNDING SOURCE SCREEN
2. PA1 key returns to DIRECTORY SCREEN

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```
Line 1 ____                FUNDING SOURCES FOR POSITION XXXXX        POS SCREEN __
Line 2 ____                  CURRENT BUDGET $ XXXXXXXX±  FTE XXX.XX±
Line 3 ____ ACCOUNT XXXXXXX-XX                                       PAGING SCREEN __
Line 4 ____ CURRENT BUDGET $ XXXXXXXX±  FTE XXX.XX±   BASE BUDGET $ XXXXXXXX± FTE XXX.XX±
                       CONTINUING:  $         FTE    TEMPORARY:     $          FTE
Line 5 ____    ANNIVERSARY        XXXXXXXX±                      XXXXXXXX±
Line 6 ____    REGRADE            XXXXXXXX±
Line 7 ____    RECLASS            XXXXXXXX±
Line 8 ____    REVISION           XXXXXXXX±  XXX.XX±             XXXXXXXX±  XXX.XX±
Line 9 ____    PROF SAL INCREASE  XXXXXXXX±                      XXXXXXXX±
Line10 ____          TOTAL....    XXXXXXXX±  XXX.XX±             XXXXXXXX±  XXX.XX±
Line11 ____ EXPENDED TO DATE $ XXXXXXXX.XX±  FTE XXX.XX±

Line12 ____ ACCOUNT XXXXXXX-XX                                       PAGING SCREEN __
Line13 ____ CURRENT BUDGET $ XXXXXXXX± FTE XXX.XX±    BASE BUDGET $ XXXXXXXX± FTE XXX.XX±
                       CONTINUING   $         FTE    TEMPORARY:     $          FTE
Line14 ____    ANNIVERSARY        XXXXXXXX±                      XXXXXXXX±
Line15 ____    REGRADE            XXXXXXXX±
Line16 ____    RECLASS            XXXXXXXX±
Line17 ____    REVISION           XXXXXXXX±  XXX.XX±             XXXXXXXX±  XXX.XX±
Line18 ____    PROF SAL INCREASE  XXXXXXXX±                      XXXXXXXX±
Line19 ____          TOTAL...     XXXXXXXX±  XXX.XX±             XXXXXXXX±  XXX.XX±
Line20 ____ EXPENDED TO DATE $ XXXXXXXX.XX±  FTE XXX.XX±
```

NOTES:

1. This screen provides a break-out of the budget for a position by funding source.

2. The only keyable fields on the screen are:
   2.1 Line 1 - POS SCREEN: by entering an X in the field and depressing ENTER the corresponding POSITION SCREEN is displayed.
   2.2 Lines 3 and 12 - PAGING SCREEN: by entering an X in the indicated field and depressing ENTER, the first occurrence of the corresponding account will be displayed on the PAGING SCREEN.

3. PA1 key returns to DIRECTORY SCREEN.

4. To view additional FUNDING SOURCES for this POSITION, depress ENTER key. The second FUNDING SOURCE currently displayed will be displayed in Lines 3-11 with the additional FUNDING SOURCE displayed in Lines 12-20.

CHAPTER VIII. FUNDING SOURCE SCREEN

The FUNDING SOURCE SCREEN will display a maximum of two sources of funds for the requested POSITION.

I. Obtaining the FUNDING SOURCE SCREEN

The screen is obtained by requesting to transfer to it from the POSITION SCREEN, Line 15.

II. Using the FUNDING SOURCE SCREEN

While the FUNDING SOURCE SCREEN is an inquiry only screen, the following options are available to the user:

PAGING - if more than two funding sources support this POSITION, the others may be viewed

CROSS TO POSITION SCREEN

CROSS TO PAGING SCREEN - allows user to look at detail comprising the current status of a FUNDING SOURCE

A. PAGING

To view additional FUNDING SOURCES for this POSITION, depress the ENTER key. The second account on the current screen will become the first displayed on the new screen. The next FUNDING SOURCE will appear in Lines 12-20.

B. CROSS TO POSITION SCREEN

In order to return to the POSITION SCREEN for this POSITION, place an X in the POS SCREEN ___ field in Line 1 and depress the ENTER key.

C. CROSS TO PAGING SCREEN

For any displayed SOURCE OF FUNDS enter an X in that account's PAGING SCREEN ___ field (either Line 3 or 12) and depress the ENTER key. You will transfer to the BUDGET PAGING SCREEN to the first occurence of the respective account, scan the POSITION field on the PAGING SCREEN to locate the line or lines that apply to the POSITION with which you are working. (This may mean PAGING through the BUDGET PAGING SCREEN).

III. ERROR MESSAGES AND RECOVERY PROCEDURES

A. NO ADDITIONAL FUNDING SOURCES ON FILE FOR THIS POSITION

You have reached the last FUNDING SOURCE for this POSITION. Continue with next POSITION (transfer to DIRECTORY SCREEN using PA1 key or back to POSITION SCREEN and enter next request in Line 15) or return to DIRECTORY for next action.

B. ERROR HAS OCCURRED - CORRECT HIGHLIGHTED FIELDS

Request has been made to cross to PAGING SCREEN on a PAGING SCREEN ___ field (either Line 3 or 12) for which no ACCOUNT appears in the ACCOUNT field. Re-enter request for an appropriate ACCOUNT transfer or enter appropriate action (i.e., PA1 key to return to DIRECTORY SCREEN).

```
Line 1 ____             FUNDING SOURCES FOR POSITION XXXXX       POS SCREEN __
Line 2 ____           CURRENT BUDGET $ XXXXXXXX±  FTE XXX.XX±
Line 3 ____ ACCOUNT XXXXXXX-XX                                  PAGING SCREEN __
Line 4 ____ CURRENT BUDGET $ XXXXXXXX±  FTE XXX.XX±   BASE BUDGET $ XXXXXXXX± FTE XXX.XX±
                       CONTINUING:  $        FTE    TEMPORARY:    $          FTE
Line 5 ____    ANNIVERSARY        XXXXXXXX±                    XXXXXXXX±
Line 6 ____    REGRADE            XXXXXXXX±
Line 7 ____    RECLASS            XXXXXXXX±
Line 8 ____    REVISION           XXXXXXXX±  XXX.XX±           XXXXXXXX±  XXX.XX±
Line 9 ____    PROF SAL INCREASE  XXXXXXXX±                    XXXXXXXX±
Line10 ____        TOTAL....      XXXXXXXX±  XXX.XX±           XXXXXXXX±  XXX.XX±
Line11 ____ EXPENDED TO DATE $ XXXXXXXX.XX±  FTE XXX.XX±

Line12 ____ ACCOUNT XXXXXXX-XX                                   PAGING SCREEN __
Line13 ____ CURRENT BUDGET $ XXXXXXXX± FTE XXX.XX±    BASE BUDGET $ XXXXXXXX± FTE XXX.XX±
                       CONTINUING   $        FTE    TEMPORARY:    $          FTE
Line14 ____    ANNIVERSARY        XXXXXXXX±                    XXXXXXXX±
Line15 ____    REGRADE            XXXXXXXX±
Line16 ____    RECLASS            XXXXXXXX±
Line17 ____    REVISION           XXXXXXXX±  XXX.XX±           XXXXXXXX±  XXX.XX±
Line18 ____    PROF SAL INCREASE  XXXXXXXX±                    XXXXXXXX±
Line19 ____        TOTAL...       XXXXXXXX±  XXX.XX±           XXXXXXXX±  XXX.XX±
Line20 ____ EXPENDED TO DATE $ XXXXXXXX.XX±  FTE XXX.XX±
```

NOTES:

1. This screen provides a break-out of the budget for a position by funding source.

2. The only keyable fields on the screen are:
   - 2.1 Line 1 - POS SCREEN: by entering an X in the field and depressing ENTER the corresponding POSITION SCREEN is displayed,
   - 2.2 Lines 3 and 12 - PAGING SCREEN: by entering an X in the indicated field and depressing ENTER, the first occurrence of the corresponding account will be displayed on the PAGING SCREEN.

3. PA1 key returns to DIRECTORY SCREEN.

4. To view additional FUNDING SOURCES for this POSITION, depress ENTER key. The second FUNDING SOURCE currently displayed will be displayed in Lines 3-11 with the additional FUNDING SOURCE displayed in Lines 12-20.

GLOSSARY

ACCOUNT	A 9-digit numeric field which includes a 1-digit campus code (1-5), a 1-digit ledger code (0-9), a 5-digit number which makes the account unique within campus and ledger and a 2-digit budget pool to categorize the expenditure. NOTE: The budget pool used in the POSITION CONTROL SYSTEM is only 2 digits as opposed to the 3-digit pool used in FRS (The 3rd digit, zero, is dropped for purposes of position control). SOURCE: BCA source document
AMOUNT	An 8-digit numeric field that reflects the dollar amount added or deducted by the transaction. CODING: XXXXXXXX (no decimal; whole dollar) SOURCE: BCA source document
APPT END DATE	A 2-position alphanumeric field reflecting the end date of the appointment. CODING: FX - end of fall, year X SX - end of spring, year X SOURCE: Faculty personnel
APPT NO	A 1-digit numeric field indicating the number of years of this appointment. CODING: 0-9 SOURCE: Faculty personnel
APPT TYPE	A 1-digit numeric field designating type of appointment. CODING: 0 - Continuous appt. paid monthly 1 - 9 mos. appt. paid over 9 mos. 2 - 9 mos. appt. paid over 12 mos. 3 - 10 mos. appt. paid over 10 mos. 4 - 10 mos. appt. paid over 12 mos. 5 - 12 mos. appt. paid over 12 mos. 6 - 7 - 8 - 9 - Special payment terms

	SOURCE: Faculty personnel
BCA	A 4-digit numeric field that partially identifies the specific source document from which entry was made. SOURCE: BCA source document (assigned in budget office)
BCA DATE	A 6-digit numeric field containing the date the BCA source document was approved in budget office. CODING: MMDDYY SOURCE: BCA source document
BUDGET STATUS	A 1-position alphanumeric field designating the type of budgeted position. CODING: C - Continuing T - Temporary SOURCE: Personnel office
CAMPUS	A 1-digit numeric field that specifies the applicable campus for the transaction/inquiry. CODING: 1 - Boulder/Central 3 - Denver 4 - Colorado Springs 5 - Regents SOURCE: BCA source document
C/T	A 1-position alphanumeric field designating the type of budget change. CODING: C - Continuing (entry codes 20, 21, 2A, 2C, 2D) T - Temporary (entry codes 24, 2B) SOURCE: System generated
DESC	A 30-position alphanumeric field containing the description of the transaction. SOURCE: BCA source document

ENTRY CODE	A 2-position alphanumeric field defining the type of BCA TRANSACTION. CODING: 20 - Base budget entry 21 - Continuing revision 24 - Temporary revision 2A - Continuing anniversary 2B - Temporary anniversary 2C - Reclass 2D - Regrade SOURCE: BCA source document
EXPENDED TO DATE	A 10-digit numeric field reflecting accumulated expenditures to date (dollar and FTE) for the respective account and position. CODING: XXXXXXXX.XX XXX.XX SOURCE: System maintained
EXPENDITURES BY MONTH	A series of twelve 7-digit numeric fields reflecting the amount and FTE expended by month in the respective position. CODING: XXXXX.XX XXX.XX SOURCE: System maintained
FTE	A 5-digit numeric field that reflects the FTE added or deducted by transaction. CODING: XXX.XX SOURCE: BCA source document
GUAR SUMMER	A 1-position alphanumeric field indicating whether or not the position has a guaranteed summer appointment. CODING: Y - indicates yes Blank or N - indicates no SOURCE: Faculty personnel

JOBCLASS	A 6-digit numeric field identifying jobclass number for the position involved in the transaction. The first digit designates position type (e.g. 1 = classified staff). SOURCE: BCA source document
LINE	A 2-digit numeric field specifying the line of the BCA source document from which transaction was entered. SOURCE: BCA source document
NAME	A 30-position alphanumeric field containing either (1) current employee's name, or (2) VACANT or (3) employee's name with indicated date of termination in last 7 positions of name field (i.e. T: MM/DD). SOURCE: Personnel and faculty personnel
NUM FUNDING SOURCES	A 2-digit numeric field indicating the number of different accounts which fund this position. SOURCE: System generated
OPTION CODE	A 1-position alphanumeric field defining a finer classification break within a jobclass. SOURCE: Personnel office
PAGE	A 3-digit numeric field used in conjunction with the BCA number to uniquely identify the source document from which transaction was made. SOURCE: System assigned
PAYGRADE	A 2-digit numeric field reflecting the applicable paygrade for this position. SOURCE: Personnel office

POS STATUS

A 1-position alphanumeric field designating the occupancy status of the position.

CODING: A - Active
T - Terminated
L - On leave with pay
P - On leave without pay

SOURCE: Personnel and faculty personnel

POSITION

A 5-digit numeric field containing a unique number by campus assigned to this budgeted position.

CODING:

00001 - 45999	Classified staff
46000 - 46999	Hourlies
50000 - 51999	Faculty - gen fund
52000 - 52999	Faculty - non gen fund
55000 - 55999	Dept chairpersons - gen fund
56000 - 56999	Faculty - auxiliary
58000 - 58999	All other auxiliary

Following are for both gen fund and non-gen fund faculty (budget pool 20)

63000 - 63999	Lecturers
64000 - 64999	Part-time instructors
65000 - 65999	From UCD
66000 - 66999	Honors adjustment
67000 - 67999	Summer professional salaries
68000 - 68999	Professional salaries
69000 - 69999	Adjust to budget

Following apply to both gen fund and non-gen fund assistants (budget pool 15)

78000 - 78999	Adjust to budget
79000 - 79999	Assistant's salaries

Following apply to both gen fund and non-gen fund classified staff (budget pool 21)

94000 - 94999	Adjust to budget
97000 - 97999	Adjust to budget
98000 - 98999	Adjust to budget
99000 - 99998	Adjust to budget
9XXXX	Shadow position where XXXX = primary position

SOURCE: BCA source document

POSITION TYPE	A 1-digit numeric field categorizing the type of position (this is coded on source document as first position of 6-digit jobclass number). CODING: 1 - State classified staff 2 - Classified staff (non-state) 3 - Unclassified executive 4 - Faculty 5 - Student 6 - Training classification 7 - House staff 8 - Retirees SOURCE: BCA source document
RETIREMENT DATE	A 2-digit numeric field designating the year of retirement. SOURCE: Faculty personnel
ROST	A 1-position alphanumeric field which designates whether or not the person in position is rostered elsewhere. CODING: Y - yes (person in position is rostered through a different position) Blank or N - no SOURCE: Faculty personnel
SOC SEC	A 9-digit numeric field containing the social security number of employee currently in position. SOURCE: Personnel and faculty personnel
STEP	A 1-digit numeric field designating the pay step current employee is on in respective paygrade. CODING: 1 - 7 SOURCE: Personnel

TENURE	A 1-position alphanumeric field indicating whether incumbent of position has tenure. CODING: Y - yes Blank or N - no SOURCE: Faculty personnel
YEAR	A 2-digit numeric field specifying the fiscal year of the transaction/inquiry. SOURCE: BCA source document

THE UNIVERSITY OF TENNESSEE

AUTOMATED FINANCIAL/ACCOUNTING SYSTEM

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A new, automated, financial/accounting system has recently been developed and installed at The University of Tennessee. The new system is a data base system which uses the IBM Information Management System (IMS) as its primary file management software. This software has enabled us to establish a financial data base containing all of the budget and accounting data necessary for the operation of the system. The Financial Data Base has become a single repository for the accounting information of the University. The new accounting system has many advanced processing features which have made the accounting data of the University more accessible to users and easier to organize and classify in meaningful ways. The intent of this paper is to describe The University of Tennessee automated accounting system and the Financial Data Base on which it operates. The accounting features of the system will be discussed, and sample reports will be presented which represent the output of the system.

I. BACKGROUND

The University of Tennessee is a multi-campus institution with a collective enrollment of over 40,000 students. The five major campuses, while enjoying a high degree of autonomy, are under the overall jurisdiction of a Central Administration located on the Knoxville Campus. The financial/accounting functions of the University are under the control of the Central Administration.

In 1974, the President's Staff approved an overall plan for the development of a Management Information System (MIS) for the University. The creation of a financial MIS was a key element of this plan which called for the design and development of a financial data base to serve as a single repository of the financial/accounting information of the University and to form the basis for a financial MIS. The project was to be conducted in three phases. The first phase resulted in the design of a "reporting" financial data base to be used for the production of ad hoc financial reports, to prove the data base design, and to be a resource for the testing of later financial systems. The second phase involved the conversion, loading and periodic refreshing of the reporting data base with current accounting data. Finally, the third phase was the design, development and implementation of a new financial/accounting system to operate from the Financial Data Base, replacing the old system.

The third phase was completed in January of 1978 with the successful installation of the new data base oriented financial/accounting system. Currently, we are processing between 75,000 and 100,000 primary financial transactions per month through the system, and posting and reporting on some 18,000 University accounts. The University of Tennessee automated accounting system is the cumulation of over two calendar years and sixteen man-years of effort.

II. DATA PROCESSING ENVIRONMENT

The financial/accounting system was developed and operates on the IBM 360/65 and the IBM 370/148 computer systems under OS/MVT. It was designed to utilize the IBM Information Management System (IMS) as its primary file management system.

The majority of the computer programs in the system are written in ANSI COBOL. In addition, however, both the EASYTRIEVE and MARK IV languages are available on our computer and are used for ad hoc retrievals and reporting. Programs in these languages are occasionally incorporated into our systems on a permanent basis.

At The University of Tennessee, data base oriented systems are developed and operated in coordination with, and using the resources of, our Data Base Administration unit. These resources include two powerful support systems: the "Code Support System", and an expanded data element dictionary package which we refer to as our "Data Resource Catalogue". The Code Support System allows any of our COBOL programs access, via IMS, to a codes data base containing the values and translations of most University codes. This permitted us to develop programs which are, for the most part, independent of embedded codes and relatively insensitive to code changes. The Data Resource Catalogue is a significant documentation tool that has allowed us to develop and maintain our system and program documentation on the computer. It, too, is a data base system.

Data Base Administration also provides the systems for the backup and recovery of the financial data bases and for ensuring access security to the data bases. In general, they maintain our data base development and operating environment.

III. THE FINANCIAL/ACCOUNTING SYSTEM

A conceptual overview of the financial/accounting system is shown in Figure 1. It is entirely a transaction driven, batch processing system. The first component consists of those subsystems which edit and control the incoming financial transactions and which perform a number of ancillary functions, such as the preparation of disbursement voucher checks. The second component generates the secondary transactions (discussed below) required by the system and posts all transactions to the various individual data bases which, taken together, comprise the Financial Data Base. The third component consists of a number of reporting subsystems to produce ledgers and many types of reports. A tabulation of the reports routinely generated by the financial/accounting system is presented in Figure 2.

The Financial Data Base is actually composed of four individual data bases: the ledger data base, the activity data base, the purchase order data base, and the encumbrance data base. The physical and logical structures of these data bases are shown in Figure 3. The ledger data base, being the primary data base of the system, contains account balances at the end of a number of

AN OVERVIEW OF A FINANCIAL MANAGEMENT INFORMATION SYSTEM FOR THE UNIVERSITY OF TENNESSEE

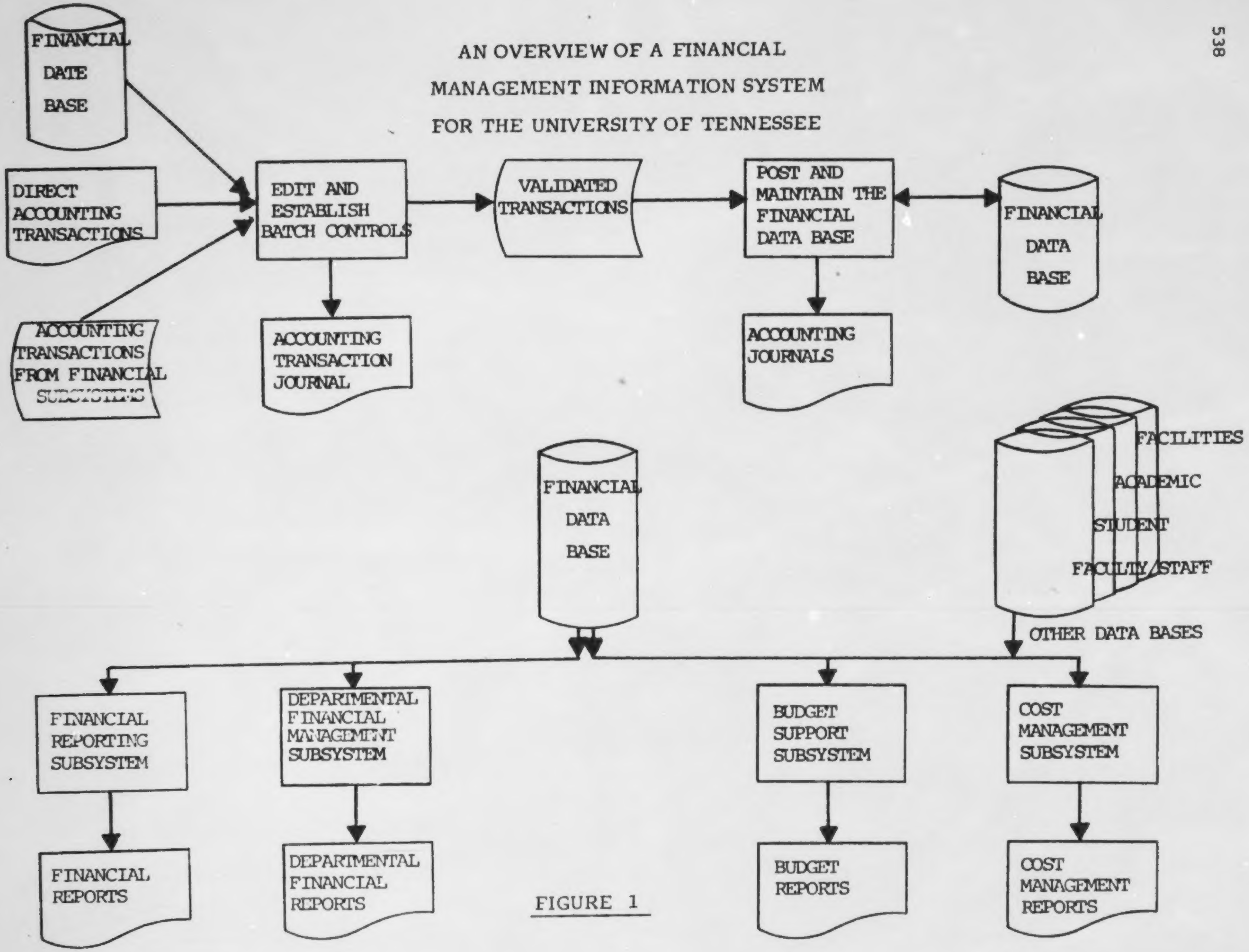
FINANCIAL DATE BASE
DIRECT ACCOUNTING TRANSACTIONS
ACCOUNTING TRANSACTIONS FROM FINANCIAL SUBSYSTEMS
EDIT AND ESTABLISH BATCH CONTROLS
ACCOUNTING TRANSACTION JOURNAL
VALIDATED TRANSACTIONS
POST AND MAINTAIN THE FINANCIAL DATA BASE
ACCOUNTING JOURNALS
FINANCIAL DATA BASE
FINANCIAL DATA BASE
FACILITIES
ACADEMIC
STUDENT
FACULTY/STAFF
OTHER DATA BASES
FINANCIAL REPORTING SUBSYSTEM
DEPARTMENTAL FINANCIAL MANAGEMENT SUBSYSTEM
BUDGET SUPPORT SUBSYSTEM
COST MANAGEMENT SUBSYSTEM
FINANCIAL REPORTS
DEPARTMENTAL FINANCIAL REPORTS
BUDGET REPORTS
COST MANAGEMENT REPORTS

FIGURE 1

FIGURE 2

FINANCIAL MANAGEMENT INFORMATION SYSTEM REPORTS

The University of Tennessee

MTRS Subsystem

- Cash Position Statement
- Balance Sheet
- Statement of Current Unrestricted Revenues
- Statement of Current Restricted Revenues
- Statement of Current Unrestricted Expenditures
- Statement of Current Unrestricted Expenditures by Function
- Statement of Current Restricted Expenditures
- Statement of Current Restricted Funds
- Statement of Loan Funds
- Statement of Notes Receivable
- Statement of Endowment Funds
- Statement of Life Income Funds
- Statement of General Funds
- Statement of Plant Fund Expenditures
- Unexpended Plant Fund Expenditure Account Activity Analysis
- Retirement of Indebtedness Funds Schedule of Assets
- Statement of Retirement of Indebtedness Funds
- Monthly Treasurer's Report Index
- Statement of Agency Fund Expenditures
- Statement of Agency Funds
- Statement of Plant Funds
- Retirement of Indebtedness Funds Addition Activity Analysis

FIGURE 2

FINANCIAL MANAGEMENT INFORMATION SYSTEM REPORTS

Budget Subsystem

Budget Schedule A-2

Budget Request Summary - Exhibit A

Actual and Budgeted Expenditures Reports by Budget Entity

THEC Report of Actual Expenditures

THEC Report of Revised Budget

Budget Summary Report

Detail Budget Schedule

Summary by Object Code

Original Budget Summary by Object Code

Balance Control and Budget Summary File Report

Estimated Income Summary Report

THEC Report of Probable Expenditures

THEC Report of Budget Requested

General Transaction Edit Subsystem

Purchase Order Data Base Update Audit Trail

Purchase Order Historical File Audit

Purchase Order Reinstatement Report

Accounting Transaction Journal

General Transaction Edit Entry Error Report

Batched Voucher Checks

Batched Check Reconciliation Cards

Fee Refund Cards

Disbursement Voucher Checks and Stubs

Disbursement Check Reconciliation Cards

Check Register

Log of Batches Deleted from the General Transaction Edit

FIGURE 2

FINANCIAL MANAGEMENT INFORMATION SYSTEM REPORTS

General Ledger Subsystem

- Departmental Expense Ledgers
- Grant Expense Ledgers
- General and Subsidiary Ledgers

General Financial Reports

- Fiscal Year Segment Update Audit Trail
- Activity Data Base Update Audit Trail
- SFNFYPRV Segment Insert Audit Trail
- End of Year Fiscal Year Segment Update Audit Trail
- Attribute Request Edit Report
- Chart of Accounts
- Account Attribute Report
- Expenditure Analysis Report Request Page
- General Funds Budget Analysis Report
- Restricted Budget Analysis Report
- Attribute Table/Grant Segment Maintenance Report
- Schedule of Changes in Fund Balances
- Schedule of Current Revenues
- Schedule of Current Funds Expenditures
- Detail Staff Benefits Report
- Summary of Staff Benefits Report

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LEDGER DATA BASE

PHYSICAL VIEW

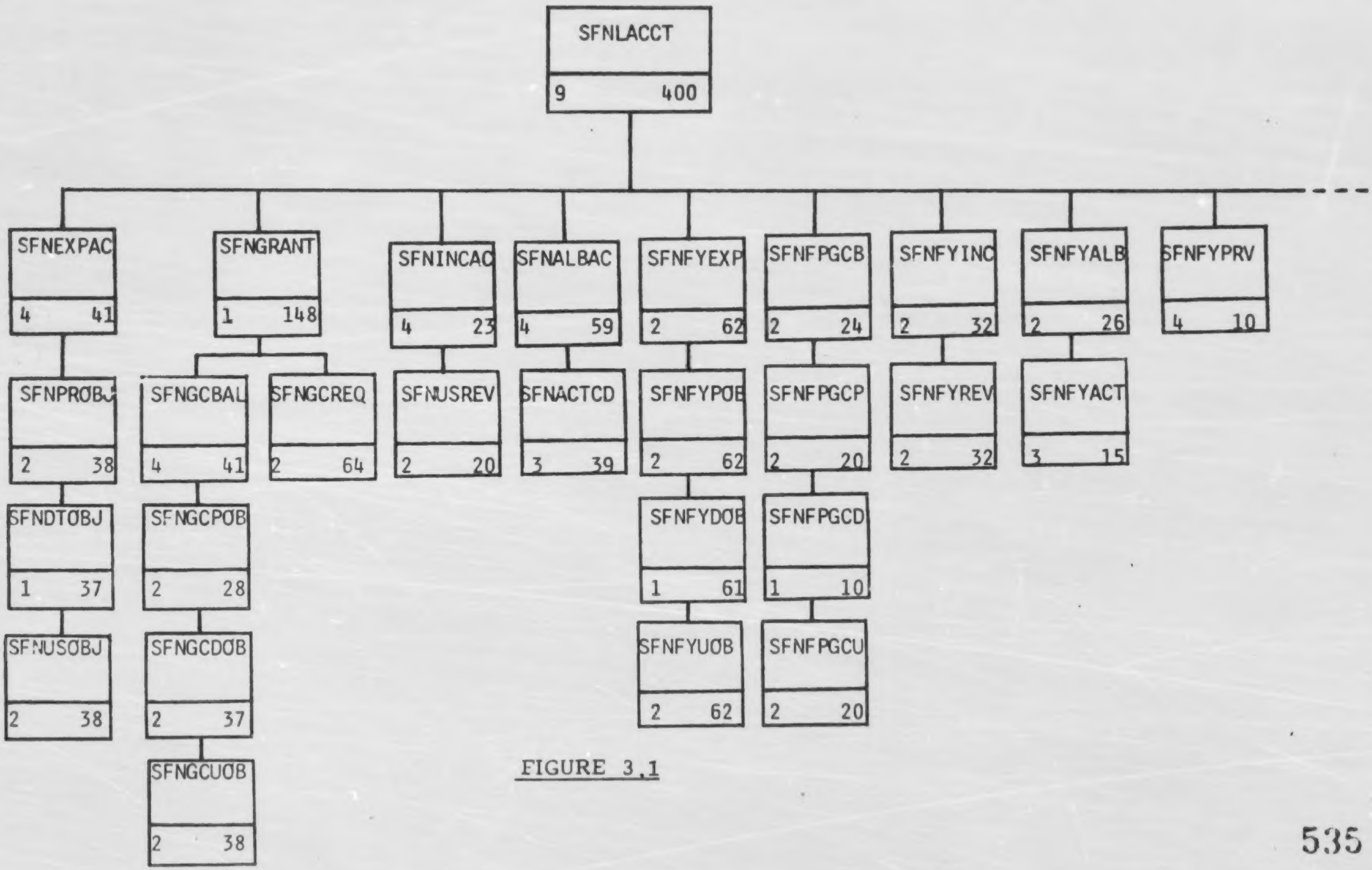


FIGURE 3.1

ACTIVITY DATA BASE

PHYSICAL VIEW

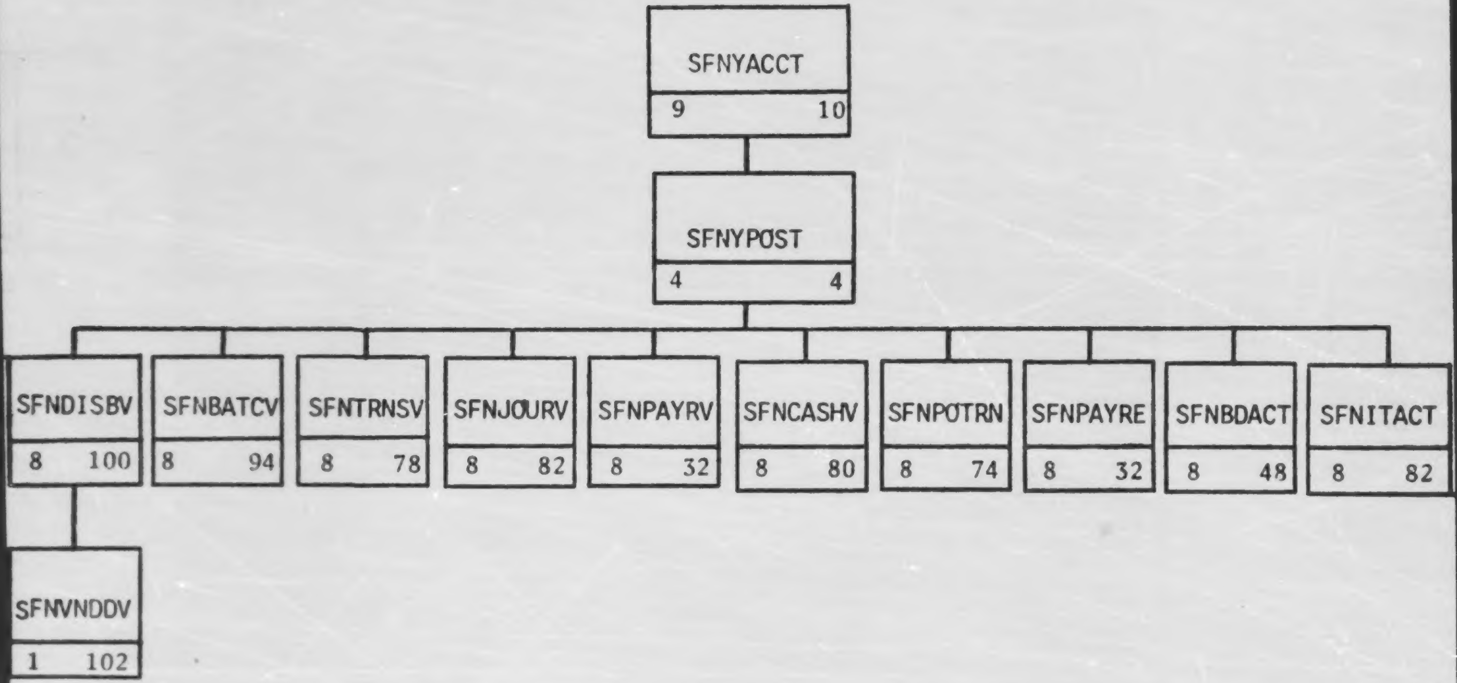


FIGURE 3.2

FIGURE 3.3

PURCHASE ORDER DATA BASE

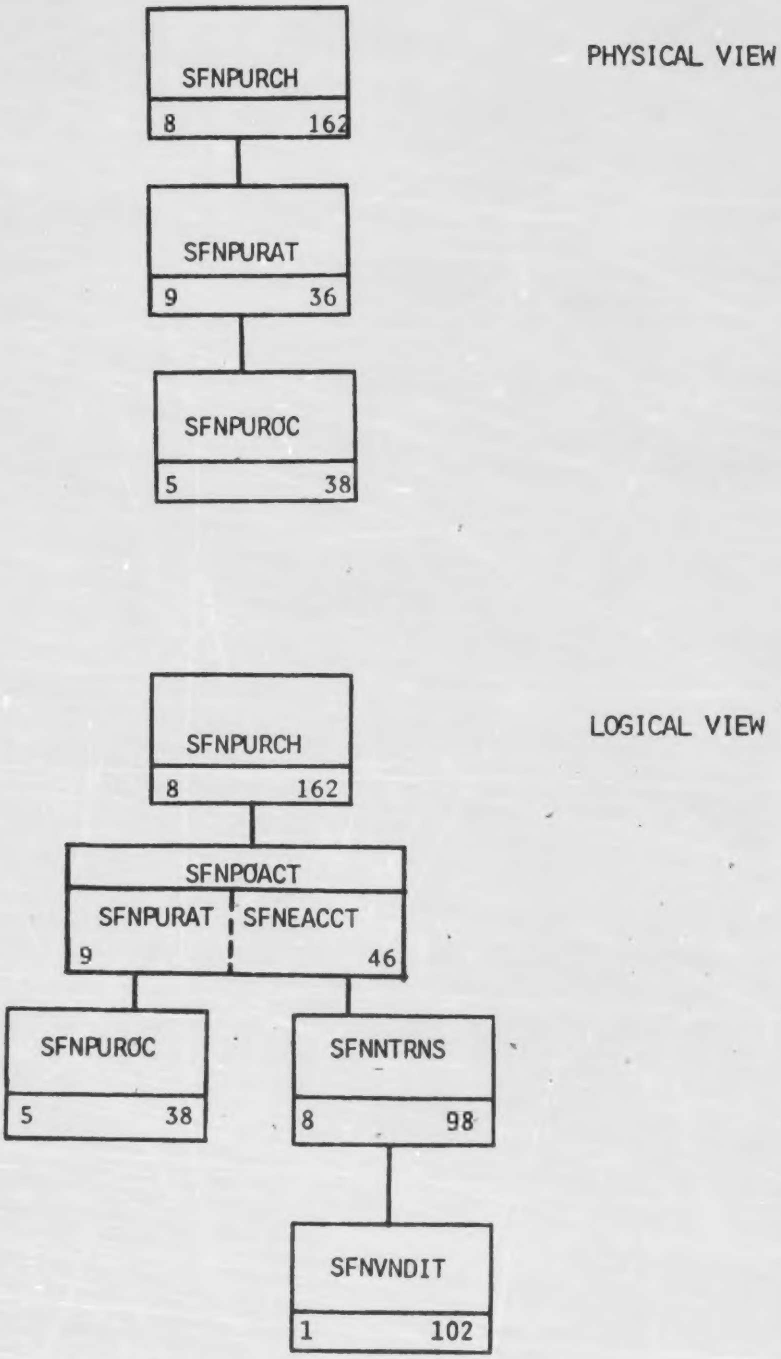
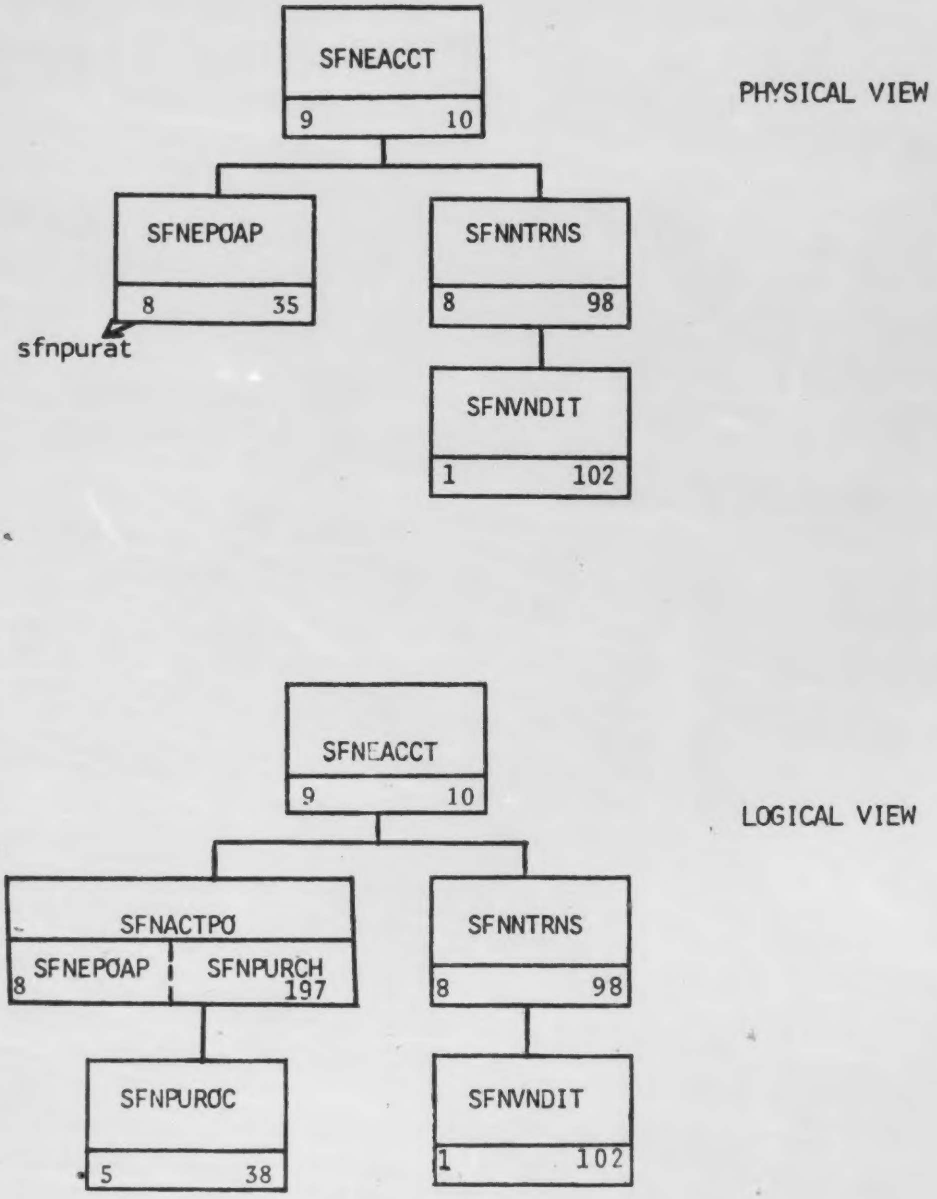


FIGURE 3.4

ENCUMBRANCE DATA BASE



accounting periods. The other data bases in the system contain the detail data to support those balances. The key of the root segment in the ledger data base is, of course, the account number. In general, the key of the second hierarchical level of this data base is the fiscal period to which subordinate data corresponds, thus allowing us to maintain the account balances for several fiscal periods at one time on the data base. The ledger data base not only contains current fiscal year account balances, but also contains projected budget data for future fiscal years, and up to five years of historical data.

The activity data base contains the individual detailed transactions by account, period and reference number which have been posted to the ledger data base. It is always possible to go from the account balances of one period to the next on the ledger data base by applying to the account the transactions for the period from the activity data base.

The purchase order and encumbrance data bases are keyed on purchase order number and account number, respectively. These data bases contain information concerning the outstanding purchase orders for the fiscal year. These data bases are accessed via their interrelated logical views: by purchase order, if we are adding or changing purchase order data on the data base, or by account, if we are relieving a purchase order as a result of an expenditure. These four data bases contain all of the data needed for the operation of the financial system.

IV. SYSTEM FEATURES

The new automated financial/accounting system has many advanced processing features which, hopefully, make the accounting data of the University more accessible to users and easier to organize and classify in meaningful ways.

Early in the design of the system, we recognized that if we were to use an account number structure that embedded codes for all the ways in which we might want to organize and classify financial data, that the account number would have to be thirty to forty characters long. Instead, we elected a different approach. This system provides for a consistent nine-character account number with good sight recognition properties (see Figure 4) which enables the user to identify the nature of the account by looking at the account number. The attributes of an account, which would have been embedded in the account number itself, were moved into a separate table in the root segment of the ledger data base. These are attributes such as the fund, function, account name, responsible person, and so on, associated with an account. These attributes serve as the basis for classifying and reporting account data. A tabulation of the attributes currently maintained for an account is presented in Figure 5. With this approach, we are no longer limited to the attributes that can be contained in a long unwieldy account number, and we can add or change attributes at will without changing the account number. For overall reporting flexibility, this is one of the most important features of the system.

In our new system, we have built in the capability of editing, posting and processing in two or more periods simultaneously. That is, we can begin processing data in a new accounting

FIGURE 4

THE UNIVERSITY OF TENNESSEE

Expenditure Account Number Structure

I. Appropriation Expenditure Accounts

```
E   XX XX XX XX
|   |  |  |  |
|   |  |  |  Subaccount or blank
|   |  |  Department of Account Number
|   |  College or Major Division
|   University Budget Entity
Fund Group Identifier (Appropriation Accounts)
```

Example: E170146ƀƀ

II. Restricted Expenditure Accounts

```
E   XX XX XX XX
|   |  |  |  |
|   |  |  |  Sequential Grant Number
|   |  |  Department of Account
|   |  College or Major Division
|   University Budget Entity
Fund Group Identifier (Restricted Accounts)
```

Example: R01102028

FIGURE 5

SELECTED ACCOUNT ATTRIBUTES

1. Recording Number
2. Account Type
3. Account Name (Short)
4. Account Name Sort Key
5. Budget Entity
6. Reporting Vice Chancellor Area
7. Reporting College or Major Division
8. Reporting Department
9. Reporting Sub-department
10. Previous Account Number
11. Fund
12. Grant or Contract Number
13. Letter of Credit
14. Responsible Person ID (SSN)
15. Responsible Person Name
16. Responsible Person Sort Key
17. Responsible Person Address
18. Major Organizational Unit
19. Plant Fund File Reference Number
20. Ledger Posting Control Flag
21. Related Balance Account
22. Expenditure Function
23. Required Budget/Expending Level
24. Offset Account Number
25. Staff Benefits Indicator
26. Staff Benefits Account Number
27. Student Aid Type
28. Major/Minor Source of Funds
29. Income Account Sequence Number
30. Asset/Liability/Balance Type

FIGURE 5

31. Asset/Liability/Balance Sequence Number
32. Account Name (Long)
33. Loan Fund Category
34. Use of Income
35. Account Control Level
36. Related Income Account
37. Ledger Print Control Flag
38. Account Activation Status
39. Account Activation Date
40. Last Activity Date
41. Grant Principal Investigator Name
42. Grant Principal Investigator Identifier
43. Grant Fiscal Period Beginning Date
44. Grant Fiscal Period Ending Date
45. Grant/Contract Project Title
46. Grant/Contract Award Number
47. Grant/Contract Overhead Calculation Code
48. Grant/Contract Required Financial Activity Frequency
49. Grant/Contract Required Financial Activity Type
50. Grant/Contract Work Location
51. Grant/Contract Agency
52. Grant/Contract Cost-Sharing Percentage or Amount

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period before the previous period has been closed. This capability also applies across the fiscal year boundary, and it has materially eased problems caused by delays in the monthly closing operation.

The financial system automatically generates a variety of secondary transactions as a result of a primary financial transaction. All University transactions are automatically offset against an appropriate, predetermined cash account in the fund corresponding to the primary transaction. Cash account balances are then routinely reported and compared to bank account balances to provide an overall control for the system. In addition, expenditure transactions on restricted expenditure accounts automatically result in the generation of secondary transactions to the related income and balance accounts. This means that earned restricted income is reflected in the financial statements immediately upon posting of the expenditure. Other special purpose transactions, such as staff benefit expenditure transactions, are dynamically modified before posting based upon established criteria. As a result of this ability to generate secondary transactions, the necessity of making many end of month adjusting entries has been eliminated from the closing process.

The new system provides for the true separation and accounting of the University financial data by fund. Each fund is treated as a complete, separately balanced account grouping consisting of income, expenditure, asset, liability and balance accounts. On restricted funds the system has been designed to carry and process both period-to-date and fiscal year-to-date data. Reports may be generated on either set. Since many grants and contracts are funded and accounted for on periods completely independent of the University fiscal year, period-to-date data may span many fiscal years or may be for less than one fiscal year.

Perhaps the most fundamental reports of any financial system are the ledgers. Samples of the departmental expenditure, grant and contract expenditure, and general ledgers produced by our system are shown in Figure 6. The departmental expenditure and grant and contract expenditure ledgers are, for a given account, divided into three sections. The first section displays the beginning balances, transaction activity, and ending balances by budget category for a particular month. On the departmental expenditure ledger these balances are fiscal year-to-date. On the grant and contract expenditure ledgers, the balances are grant period-to-date. The second section tabulates all of the outstanding purchase orders associated with the account. The third section is a budget analysis section, analyzing the budget, encumbrance and expenditure amounts by object code and budget category on a current month and fiscal year-to-date basis. On the grant and contract expenditure ledger, period-to-date expenditures are also analyzed and displayed.

The general ledgers are always fiscal year-to-date. That is, all transaction activity on an account for the fiscal year is displayed on every ledger. That activity is also analyzed by ledger activity code on each account ledger.

A capability has been designed into the system for the generation of interim financial reports (ledgers, balance sheets, etc.). Posting of all edited transactions occurs three times a week so that interim reports may be requested as desired throughout

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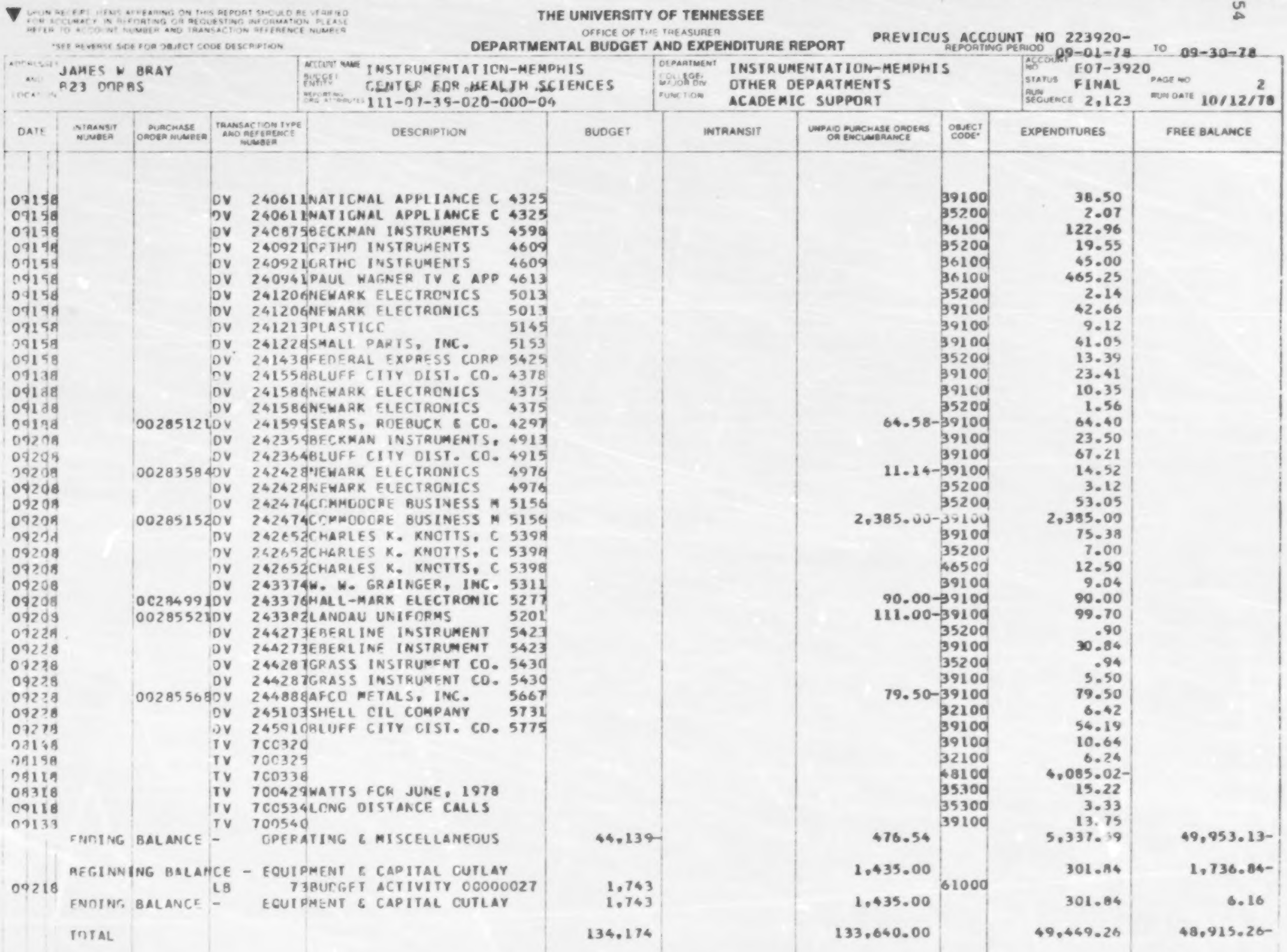
THE UNIVERSITY OF TENNESSEE
OFFICE OF THE TREASURER
DEPARTMENTAL BUDGET AND EXPENDITURE REPORT

PREVIOUS ACCOUNT NO 223920-
REPORTING PERIOD 09-01-78 TO 09-30-78

ADDRESSEE AND LOCATION	JAMES W BRAY 823 DOBBS	ACCOUNT NO	E07-3920
ACCOUNT NAME	INSTRUMENTATION-MEMPHIS	STATUS	FINAL
BUDGET ENTITY	CENTER FOR HEALTH SCIENCES	PAGE NO	1
REPORTING ORG. ATTRIBUTES	111-07-39-020-000-04	RUN SEQUENCE	2,122
DEPARTMENT	INSTRUMENTATION-MEMPHIS	RUN DATE	10/12/78
COLLEGE/ MAJOR DIV	OTHER DEPARTMENTS		
FUNCTION	ACADEMIC SUPPORT		

DATE	INTRANSIT NUMBER	PURCHASE ORDER NUMBER	TRANSACTION TYPE AND REFERENCE NUMBER	DESCRIPTION	BUDGET	INTRANSIT	UNPAID PURCHASE ORDERS OR ENCUMBRANCE	OBJECT CODE*	EXPENDITURES	FREE BALANCE
				BEGINNING BALANCE - PROFESSIONAL SALARIES	78,588		65,490.00		13,098.00	
09308			PV 19	MONTHLY			6,549.00-	121	6,549.00	
				ENDING BALANCE - PROFESSIONAL SALARIES	78,588		58,941.00		19,647.00	
				BEGINNING BALANCE - CLERICAL & SUPPORTING SALARIED	97,982		80,874.96		16,075.33	1,031.71
09308			PV 19	MONTHLY			8,087.50-	161	8,087.50	
				ENDING BALANCE - CLERICAL & SUPPORTING SALARIED	97,982		72,787.46		24,162.83	1,031.71
				BEGINNING BALANCE - OPERATING & MISCELLANEOUS	47,280-		3,779.65		1,683.31	52,742.96-
09218			LB 73	BUDGET ACTIVITY 00000027	3,141			39000		
08238		000285521	PO	LANDAU UNIFORMS			111.00	39100		
09248		000285568	PO	AFCO METALS			79.50	39100		
09088		000285832	PO	NORRELL PLASTICS			66.24	39100		
09198		000286103	PO	LIPSHAW MANUFACTURING			8.40	39100		
09058			DV 233259	ORION RESEARCH 2515				36100	216.50	
09058			DV 233259	ORION RESEARCH 2515				35200	1.39	
09058			DV 233765	AMERICAN HOSPITAL SU 2678				35200	.13	
09058			DV 233765	AMERICAN HOSPITAL SU 2678				39100	6.80	
09058			DV 233794	FISHER SCIENTIFIC CO 2802				39100	15.10	
09058			DV 233800	W. W. GRAINGER, INC. 2805				39100	13.41	
09058		00285120	DV 234175	FALK-BAKER ASSOCIATE 2831			52.75-	39100	52.75	
09058			DV 234175	FALK-BAKER ASSOCIATE 2831				35200	1.50	
09058			DV 234360	BECKMAN INSTRUMENTS 3889				35200	5.71	
09058			DV 234360	BECKMAN INSTRUMENTS 3889				36100	1,290.00	
09098		00282636	DV 234598	BLUFF CITY DIST. CO. 3051			3.80-	39100	432.16	
09098		00283360	DV 234598	BLUFF CITY DIST. CO. 3051			437.00-	39100		
09058		00283764	DV 234613	CURRIE PEAK & FRAZIE 3028			56.60-	39100	56.60	
09058			DV 234613	CURRIE PEAK & FRAZIE 3028				35200	4.00	
09068			DV 235479	NEWMAN COMPUTER EXCH 3080				35200	5.66	
09068		00283798	DV 235479	NEWMAN COMPUTER EXCH 3080			188.95-	39100	188.95	
09068			DV 235622	NATIONAL APPLIANCE C 3426				35200	1.81	
09049			DV 235622	NATIONAL APPLIANCE C 3426				39100	38.50	
09068			DV 235624	NEWARK ELECTRONICS 3431				39100	25.49	
03068			DV 235624	NEWARK ELECTRONICS 3431				35200	1.66	
09098		00283584	DV 236251	NEWARK ELECTRONICS 3335			5.43-	39100	4.56	
09099			DV 236251	NEWARK ELECTRONICS 3335				35200	.87	
09083			DV 236279	THERMIONICS LABORATO 3396				35200	1.41	
09099			CV 236279	THERMIONICS LABORATO 3396				36100	185.00	
09088			DV 236292	AMERICAN HOSP. SUP. 3393				36100	412.00	
09098			DV 236292	AMERICAN HOSP. SUP. 3393				35200	8.24	
09088			DV 236300	BENDIX CORP. 3276				39100	40.00	
09098			DV 236300	BENDIX CORP. 3276				35200	.87	
09048			DV 237120	FISHER SCIENTIFIC 3644				36100	287.60	
09038			DV 237130	BLUFF CITY DIST. CO. 2603				39100	12.66	
09088			DV 237195	NEWARK ELECTRONICS 2591				35200	3.22	
09098			DV 237195	NEWARK ELECTRONICS 2591				39100	51.80	
09178			DV 238293	BLUFF CITY DIST. CO. 3786				39100	94.92	
09138			DV 238966	BECKMAN INSTRUMENTS 3888				36100	134.80	
09138		00285017	DV 239263	COLE-PARMER INSTRUME 4079			82.50-	39100	82.50	
09139			DV 239263	COLE-PARMER INSTRUME 4079				35200	1.33	
09138			DV 239468	BLUFF CITY DIST. 4135				36100	80.00	
09159			DV 240571	BLUFF CITY DIST. CO. 4539				39100	10.50	

FIGURE 6.1



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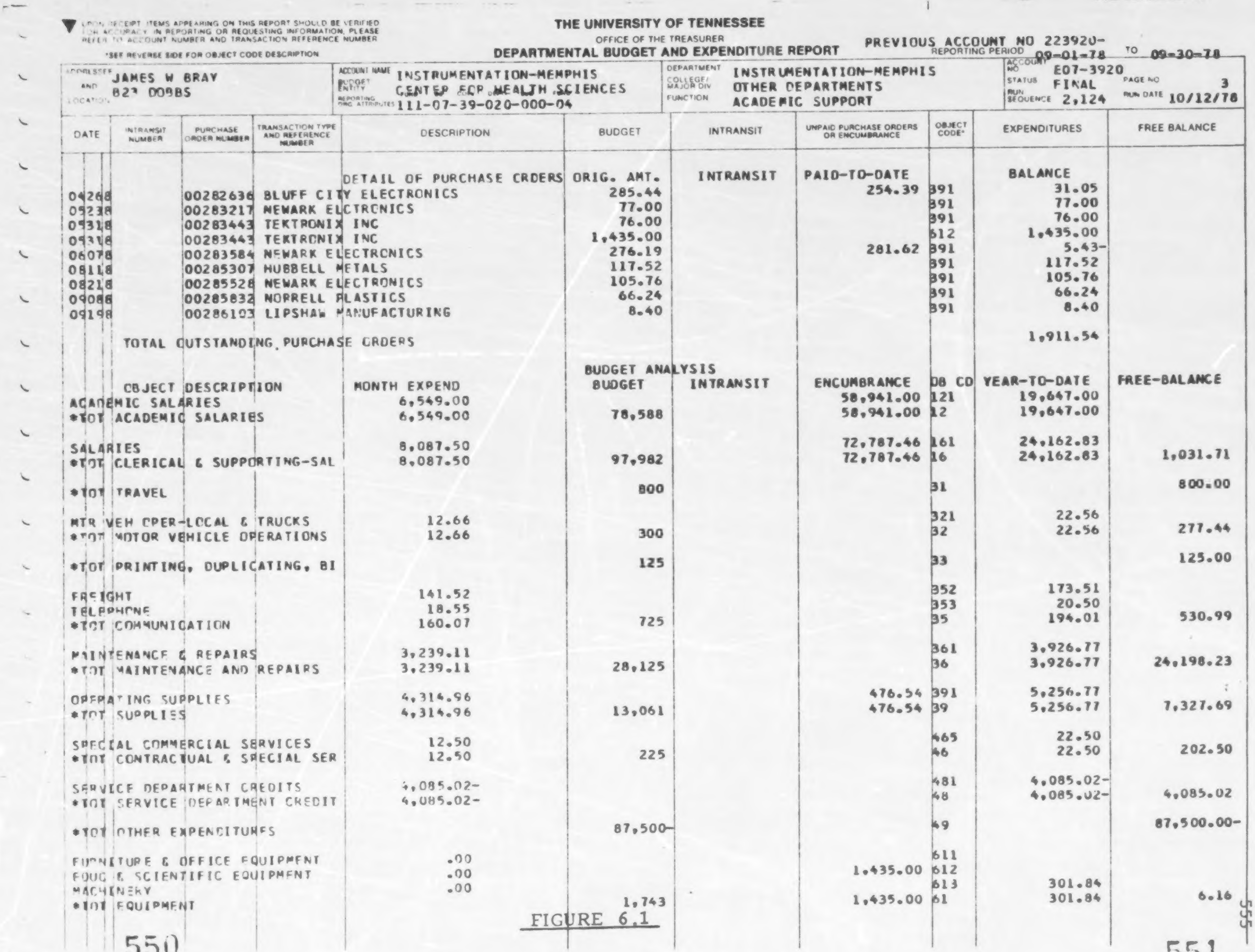
THE UNIVERSITY OF TENNESSEE
OFFICE OF THE TREASURER
DEPARTMENTAL BUDGET AND EXPENDITURE REPORT

PREVIOUS ACCOUNT NO 223920-
REPORTING PERIOD 09-01-78 TO 09-30-78

ADDRESSEE AND LOCATION	JAMES W BRAY 823 DOBBS	ACCOUNT NO	E07-3920
ACCOUNT NAME	INSTRUMENTATION-MEMPHIS	STATUS	FINAL
BUDGET ENTITY	CENTER FOR HEALTH SCIENCES	PAGE NO	2
REPORTING ORG ATTRIBUTES	111-07-39-020-000-04	RUN SEQUENCE	2,123
DEPARTMENT	INSTRUMENTATION-MEMPHIS	RUN DATE	10/12/78
COLLEGE/MAJOR DIV	OTHER DEPARTMENTS		
FUNCTION	ACADEMIC SUPPORT		

DATE	INTRANSIT NUMBER	PURCHASE ORDER NUMBER	TRANSACTION TYPE AND REFERENCE NUMBER	DESCRIPTION	BUDGET	INTRANSIT	UNPAID PURCHASE ORDERS OR ENCUMBRANCE	OBJECT CODE*	EXPENDITURES	FREE BALANCE
09158			DV 240611	NATIONAL APPLIANCE C 4325				39100	38.50	
09158			DV 240611	NATIONAL APPLIANCE C 4325				35200	2.07	
09158			DV 240875	BECKMAN INSTRUMENTS 4598				36100	122.96	
09158			DV 240921	ORTHO INSTRUMENTS 4609				35200	19.55	
09158			DV 240921	ORTHO INSTRUMENTS 4609				36100	45.00	
09158			DV 240941	PAUL WAGNER TV & APP 4613				36100	465.25	
09158			DV 241206	NEWARK ELECTRONICS 5013				35200	2.14	
09158			DV 241206	NEWARK ELECTRONICS 5013				39100	42.66	
09158			DV 241213	PLASTICO 5145				39100	9.12	
09158			DV 241228	SMALL PARTS, INC. 5153				39100	41.05	
09158			DV 241438	FEDERAL EXPRESS CORP 5425				35200	13.39	
09138			DV 241558	BLUFF CITY DIST. CO. 4378				39100	23.41	
09188			DV 241586	NEWARK ELECTRONICS 4375				39100	10.35	
09188			DV 241586	NEWARK ELECTRONICS 4375				35200	1.56	
09198		00285121	DV 241599	SEARS, ROEBUCK & CO. 4297			64.58-	39100	64.40	
09208			DV 242359	BECKMAN INSTRUMENTS, 4913				39100	23.50	
09208			DV 242364	BLUFF CITY DIST. CO. 4915				39100	67.21	
09208		00283584	DV 242428	NEWARK ELECTRONICS 4976			11.14-	39100	14.52	
09208			DV 242428	NEWARK ELECTRONICS 4976				35200	3.12	
09208			DV 242474	COMMODORE BUSINESS M 5156				35200	53.05	
09208		00285152	DV 242474	COMMODORE BUSINESS M 5156			2,385.00-	39100	2,385.00	
09208			DV 242652	CHARLES K. KNOTTS, C 5398				39100	75.38	
09208			DV 242652	CHARLES K. KNOTTS, C 5398				35200	7.00	
09208			DV 242652	CHARLES K. KNOTTS, C 5398				46500	12.50	
09208			DV 243374	W. W. GRAINGER, INC. 5311				39100	9.04	
09208		00284991	DV 243376	HALL-MARK ELECTRONIC 5277			90.00-	39100	90.00	
09208		00285521	DV 243382	LANDAU UNIFORMS 5201			111.00-	39100	99.70	
09228			DV 244273	EBERLINE INSTRUMENT 5423				35200	.90	
09228			DV 244273	EBERLINE INSTRUMENT 5423				39100	30.84	
09228			DV 244287	GRASS INSTRUMENT CO. 5430				35200	.94	
09228			DV 244287	GRASS INSTRUMENT CO. 5430				39100	5.50	
09228		00285568	DV 244888	AFCO METALS, INC. 5667			79.50-	39100	79.50	
09228			DV 245103	SHELL OIL COMPANY 5731				32100	6.42	
09278			DV 245910	BLUFF CITY DIST. CO. 5775				39100	54.19	
08148			TV 700320					39100	10.64	
08158			TV 700325					32100	6.24	
08118			TV 700338					48100	4,085.02-	
08318			TV 700429	WATTS FOR JUNE, 1978				35300	15.22	
09118			TV 700534	LONG DISTANCE CALLS				35300	3.33	
09133			TV 700540					39100	13.75	
	ENDING BALANCE -			OPERATING & MISCELLANEOUS	44,139-		476.54		5,337.39	49,953.13-
	BEGINNING BALANCE -			EQUIPMENT & CAPITAL OUTLAY			1,435.00		301.84	1,736.84-
09218			LB 73	BUDGET ACTIVITY 00000027	1,743			61000		
	ENDING BALANCE -			EQUIPMENT & CAPITAL OUTLAY	1,743		1,435.00		301.84	6.16
	TOTAL				134,174		133,640.00		49,449.26	48,915.26-

FIGURE 6,1



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THE UNIVERSITY OF TENNESSEE

OFFICE OF THE TREASURER

DEPARTMENTAL BUDGET AND EXPENDITURE REPORT

PREVIOUS ACCOUNT NO 223920-

REPORTING PERIOD 09-01-78 TO 09-30-78

ADDRESSEE AND LOCATION	JAMES W BRAY 823 DOBBS	ACCOUNT NAME BUDGET ENTITY REPORTING ORG. ATTRIBUTES	INSTRUMENTATION-MEMPHIS CENTER FOR HEALTH SCIENCES 111-07-39-020-000-04	DEPARTMENT COLLEGE/MAJOR DIV FUNCTION	INSTRUMENTATION-MEMPHIS OTHER DEPARTMENTS ACADEMIC SUPPORT

ACCOUNT NO E07-3920

STATUS FINAL

PAGE NO 3

RUN SEQUENCE 2,124

RUN DATE 10/12/78

DATE	INTRANSIT NUMBER	PURCHASE ORDER NUMBER	TRANSACTION TYPE AND REFERENCE NUMBER	DESCRIPTION	BUDGET	INTRANSIT	UNPAID PURCHASE ORDERS OR ENCUMBRANCE	OBJECT CODE*	EXPENDITURES	FREE BALANCE
				DETAIL OF PURCHASE ORDERS	ORIG. AMT.	INTRANSIT	PAID-TO-DATE		BALANCE	
04268		00282636	BLUFF CITY ELECTRONICS		285.44		254.39	391	31.05	
09238		00283217	NEWARK ELCTRONICS		77.00			391	77.00	
09318		00283443	TEKTRONIX INC		76.00			391	76.00	
09318		00283443	TEKTRONIX INC		1,435.00			612	1,435.00	
06078		00283584	NEWARK ELECTRONICS		276.19		281.62	391	5.43-	
08118		00285307	HUBBELL METALS		117.52			391	117.52	
08218		00285528	NEWARK ELECTRONICS		105.76			391	105.76	
09088		00285832	NORRELL PLASTICS		66.24			391	66.24	
09198		00286103	LIPSHAW MANUFACTURING		8.40			391	8.40	
	TOTAL OUTSTANDING PURCHASE ORDERS								1,911.54	

BUDGET ANALYSIS

OBJECT DESCRIPTION	MONTH EXPEND	BUDGET	INTRANSIT	ENCUMBRANCE	OB CD	YEAR-TO-DATE	FREE-BALANCE
ACADEMIC SALARIES	6,549.00			58,941.00	121	19,647.00	
*TOT ACADEMIC SALARIES	6,549.00	78,588		58,941.00	12	19,647.00	
SALARIES	8,087.50			72,787.46	161	24,162.83	
*TOT CLERICAL & SUPPORTING-SAL	8,087.50	97,982		72,787.46	16	24,162.83	1,031.71
*TOT TRAVEL		800			31		800.00
MTR VEH OPER-LOCAL & TRUCKS	12.66				321	22.56	
*TOT MOTOR VEHICLE OPERATIONS	12.66	300			32	22.56	277.44
*TOT PRINTING, DUPLICATING, BI		125			33		125.00
FREIGHT	141.52				352	173.51	
TELEPHONE	18.55				353	20.50	
*TOT COMMUNICATION	160.07	725			35	194.01	530.99
MAINTENANCE & REPAIRS	3,239.11				361	3,926.77	
*TOT MAINTENANCE AND REPAIRS	3,239.11	28,125			36	3,926.77	24,198.23
OPERATING SUPPLIES	4,314.96			476.54	391	5,256.77	
*TOT SUPPLIES	4,314.96	13,061		476.54	39	5,256.77	7,327.69
SPECIAL COMMERCIAL SERVICES	12.50				465	22.50	
*TOT CONTRACTUAL & SPECIAL SER	12.50	225			46	22.50	202.50
SERVICE DEPARTMENT CREDITS	4,085.02-				481	4,085.02-	
*TOT SERVICE DEPARTMENT CREDIT	4,085.02-				48	4,085.02-	4,085.02
*TOT OTHER EXPENDITURES		87,500-			49		87,500.00-
FURNITURE & OFFICE EQUIPMENT	.00				611		
EDUC & SCIENTIFIC EQUIPMENT	.00			1,435.00	612		
MACHINERY	.00				613	301.84	
*TOT EQUIPMENT		1,743		1,435.00	61	301.84	6.16

FIGURE 6.1

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THE UNIVERSITY OF TENNESSEE

OFFICE OF THE TREASURER

DEPARTMENTAL BUDGET AND EXPENDITURE REPORT

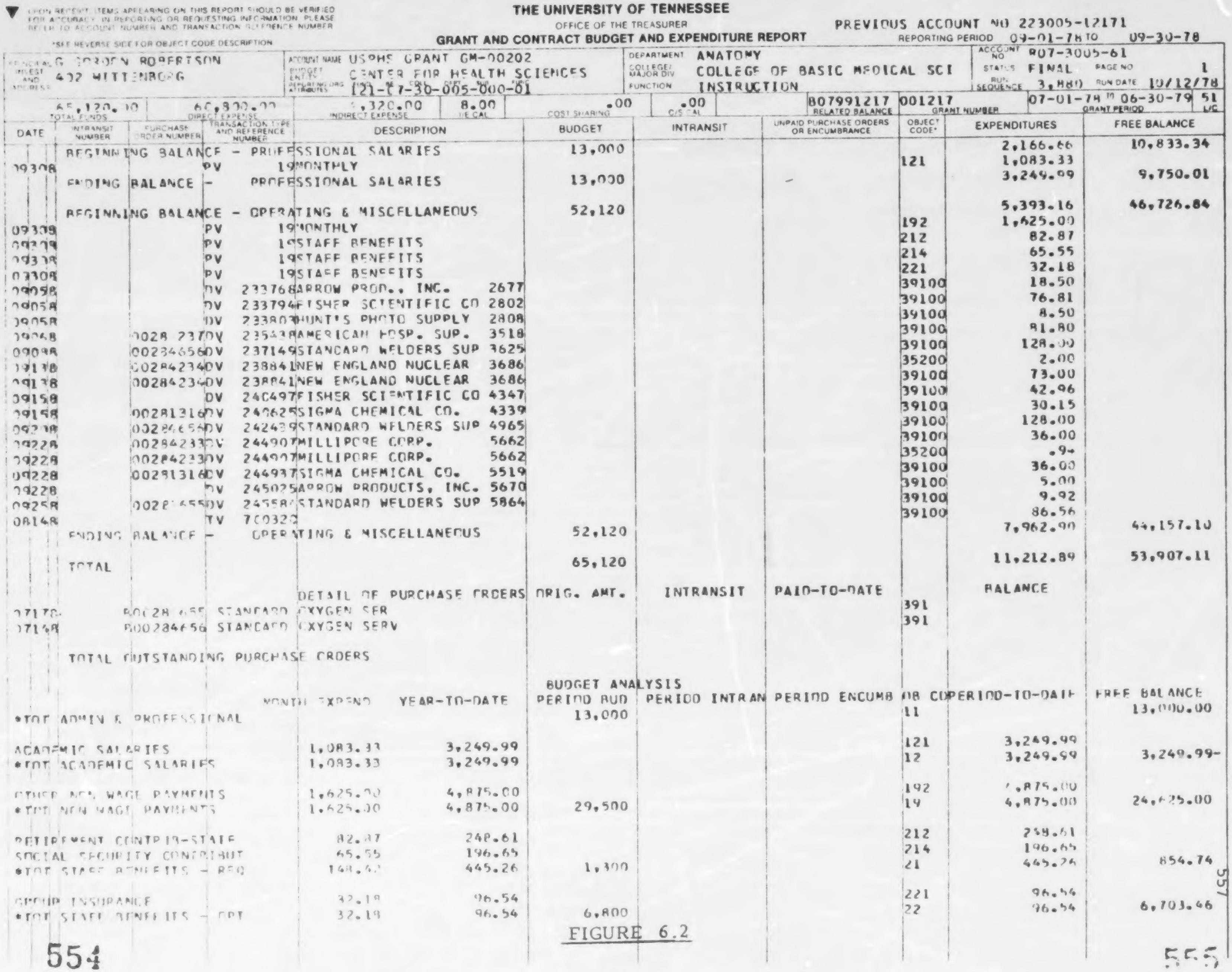
PREVIOUS ACCOUNT NO 223920-

REPORTING PERIOD 09-01-78 TO 09-30-78

ADDRESSEE AND LOCATION JAMES W BRAY 823 DOBBS	ACCOUNT NAME INSTRUMENTATION-MEMPHIS BUDGET ENTITY CENTER FOR HEALTH SCIENCES REPORTING ORG ATTRIBUTES 111-07-39-020-000-04	DEPARTMENT INSTRUMENTATION-MEMPHIS COLLEGE/MAJOR DIV OTHER DEPARTMENTS FUNCTION ACADEMIC SUPPORT	ACCOUNT NO E07-3920 STATUS FINAL PAGE NO 4 RUN SEQUENCE 2,125 RUN DATE 10/12/78

DATE	INTRANSIT NUMBER	PURCHASE ORDER NUMBER	TRANSACTION TYPE AND REFERENCE NUMBER	DESCRIPTION	BUDGET	INTRANSIT	UNPAID PURCHASE ORDERS OR ENCUMBRANCE	OBJECT CODE*	EXPENDITURES	FREE BALANCE
					BUDGET ANALYSIS					
	OBJECT	DESCRIPTION		MONTH EXPEND	BUDGET	INTRANSIT	ENCUMBRANCE	OB CD	YEAR-TO-DATE	FREE-BALANCE
	TOTAL			18,290.78	134,174		133,640.00		49,449.26	48,915.26-

FIGURE 6.1



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THE UNIVERSITY OF TENNESSEE
OFFICE OF THE TREASURER
GRANT AND CONTRACT BUDGET AND EXPENDITURE REPORT

PREVIOUS ACCOUNT NO 223005-12171
REPORTING PERIOD 09-01-78 TO 09-30-78

PRINCIPAL INVEST AND ADDRESS	G GORDON ROBERTSON 402 WITTENBORG	ACCOUNT NO	R07-3005-61
ACCOUNT NAME	USPHS GRANT GM-00202	STATUS	FINAL
BUDGET ENTITY	CENTER FOR HEALTH SCIENCES	PAGE NO	1
REPORTING ORG ATTRIBUTES	121-C7-30-005-000-01	RUN SEQUENCE	3,880
DEPARTMENT	ANATOMY	RUN DATE	10/12/78
COLLEGE/MAJOR DIV	COLLEGE OF BASIC MEDICAL SCI		
FUNCTION	INSTRUCTION		

TOTAL FUNDS	DIRECT EXPENSE	INDIRECT EXPENSE	I/E CAL	COST SHARING	C/S CAL		RELATED BALANCE	GRANT NUMBER	GRANT PERIOD	L/C
65,120.00	60,800.00	4,320.00	8.00	.00	.00		807991217	001217	07-01-78 TO 06-30-79	51

DATE	INTRANSIT NUMBER	PURCHASE ORDER NUMBER	TRANSACTION TYPE AND REFERENCE NUMBER	DESCRIPTION	BUDGET	INTRANSIT	UNPAID PURCHASE ORDERS OR ENCUMBRANCE	OBJECT CODE*	EXPENDITURES	FREE BALANCE
	BEGINNING BALANCE - PROFESSIONAL SALARIES				13,000				2,166.66	10,833.34
09308			PV 19	MONTHLY				121	1,083.33	
	ENDING BALANCE - PROFESSIONAL SALARIES				13,000				3,249.99	9,750.01
	BEGINNING BALANCE - OPERATING & MISCELLANEOUS				52,120				5,393.16	46,726.84
09309			PV 19	MONTHLY				192	1,625.00	
09279			PV 19	STAFF BENEFITS				212	82.87	
09309			PV 19	STAFF BENEFITS				214	65.55	
03308			PV 19	STAFF BENEFITS				221	32.18	
09058			DV 233768	ARROW PROD., INC. 2677				39100	18.50	
09058			DV 233794	FISHER SCIENTIFIC CO 2802				39100	76.81	
09058			DV 233807	HUNT'S PHOTO SUPPLY 2808				39100	8.50	
09068		0028 237	DV 235438	AMERICAN HOSP. SUP. 3518				39100	81.80	
09098		00284656	DV 237149	STANDARD WELDERS SUP 3625				39100	128.00	
09138		00284234	DV 238841	NEW ENGLAND NUCLEAR 3686				35200	2.00	
09138		00284234	DV 238841	NEW ENGLAND NUCLEAR 3686				39100	73.00	
09158			DV 240497	FISHER SCIENTIFIC CO 4347				39100	42.96	
09158		00281316	DV 240625	SIGMA CHEMICAL CO. 4339				39100	30.15	
09208		00284656	DV 242439	STANDARD WELDERS SUP 4965				39100	128.00	
09228		00284233	DV 244907	MILLIPORE CORP. 5662				39100	36.00	
09228		00284233	DV 244907	MILLIPORE CORP. 5662				35200	.9-	
09228		00281316	DV 244937	SIGMA CHEMICAL CO. 5519				39100	36.00	
09228			DV 245025	ARROW PRODUCTS, INC. 5670				39100	5.00	
09258		0028 655	DV 24558	STANDARD WELDERS SUP 5864				39100	9.92	
08148			TV 700322					39100	86.56	
	ENDING BALANCE - OPERATING & MISCELLANEOUS				52,120				7,962.90	44,157.10
	TOTAL				65,120				11,212.89	53,907.11

		DETAIL OF PURCHASE ORDERS	ORIG. AMT.	INTRANSIT	PAID-TO-DATE		BALANCE
07178	R0028 655	STANDARD OXYGEN SER				391	
07148	R00284656	STANDARD OXYGEN SERV				391	

TOTAL OUTSTANDING PURCHASE ORDERS

BUDGET ANALYSIS

	MONTH EXPEND	YEAR-TO-DATE	PERIOD BUD	PERIOD INTRAN	PERIOD ENCUMB	OB CD	PERIOD-TO-DATE	FREE BALANCE
*TOT ADMIN & PROFESSIONAL			13,000			11		13,000.00
ACADEMIC SALARIES	1,083.33	3,249.99				121	3,249.99	
*TOT ACADEMIC SALARIES	1,083.33	3,249.99				12	3,249.99	3,249.99-
OTHER NON WAGE PAYMENTS	1,625.00	4,875.00				192	4,875.00	
*TOT NON WAGE PAYMENTS	1,625.00	4,875.00	29,500			19	4,875.00	24,625.00
RETIREMENT CONTRIB-STATE	82.87	248.61				212	248.61	
SOCIAL SECURITY CONTRIBUT	65.55	196.65				214	196.65	
*TOT STAFF BENEFITS - REQ	148.42	445.26	1,300			21	445.26	854.74
GROUP INSURANCE	32.18	96.54				221	96.54	
*TOT STAFF BENEFITS - OPT	32.18	96.54	6,800			22	96.54	6,703.46

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FIGURE 6.2

▼ UPON RECEIPT ITEMS APPEARING ON THIS REPORT SHOULD BE VERIFIED FOR ACCURACY. IN REPORTING OR REQUESTING INFORMATION PLEASE REFER TO ACCOUNT NUMBER AND TRANSACTION REFERENCE NUMBER

*SEE REVERSE SIDE FOR OBJECT CODE DESCRIPTION

THE UNIVERSITY OF TENNESSEE

OFFICE OF THE TREASURER

GRANT AND CONTRACT BUDGET AND EXPENDITURE REPORT

PREVIOUS ACCOUNT NO 223005-12171

REPORTING PERIOD 09-01-78 TO 09-30-78

PRINCIPAL INVEST. AND ADDRESS	G GORDON ROBERTSON 402 WITTENBORG	ACCOUNT NAME	USPHS GRANT GM-00202	DEPARTMENT	ANATOMY
		BUDGET ENTITY	CENTER FOR HEALTH SCIENCES	COLLEGE/ MAJOR DIV	COLLEGE OF BASIC MEDICAL SCI
		REPORTING ORG. ATTRIBUTES	171-07-30-005-000-01	FUNCTION	INSTRUCTION

ACCOUNT NO R07-3005-61

STATUS FINAL

PAGE NO 2

RUN SEQUENCE 3,881

RUN DATE 10/12/78

TOTAL FUNDS	DIRECT EXPENSE	INDIRECT EXPENSE	I/E CAL	COST SHARING	C/S CAL		RELATED BALANCE	GRANT NUMBER	GRANT PERIOD	L/C
65,120.00	60,800.00	4,320.00	8.00	.00	.00		R07991217	001217	07-01-78 TO 06-30-79	51

DATE	INTRANSIT NUMBER	PURCHASE ORDER NUMBER	TRANSACTION TYPE AND REFERENCE NUMBER	DESCRIPTION	BUDGET	INTRANSIT	UNPAID PURCHASE ORDERS OR ENCUMBRANCE	OBJECT CODE*	EXPENDITURES	FREE BALANCE

BUDGET ANALYSIS

	MONTH EXPEND	YEAR-TO-DATE	PERIOD BUD	PERIOD INTRAN	PERIOD ENCUMB	OB CD	PERIOD-TO-DATE	FREE BALANCE
*TOT TRAVEL			1,200			31		1,200.00
FREIGHT	2.94	10.55				352	10.55	
*TOT COMMUNICATION	2.94	10.55				35	10.55	10.55-
OPERATING SUPPLIES	761.20	1,139.80				391	1,139.80	
*TOT SUPPLIES	761.20	1,139.80	7,000			39	1,139.80	5,860.20
STUDENT FEES	.00	1,385.75				441	1,385.75	
*TOT GRANTS AND SUBSIDIES		1,385.75				44	1,385.75	1,385.75-
SPECIAL COMMERCIAL SERVIC	.00	10.00				465	10.00	
*TOT CONTRACTUAL & SPECIA		10.00				46	10.00	10.00-
*TOT OTHER EXPENDITURES			2,000			49		2,000.00
*TOT INDIRECT COST			4,320			65		4,320.00
TOTAL	3,653.07	11,212.89	65,120				11,212.89	53,907.11

FIGURE 6.2

▼ UPON RECEIPT, ITEMS APPEARING ON THIS REPORT SHOULD BE VERIFIED FOR ACCURACY. IN REPORTING OR REQUESTING INFORMATION, PLEASE REFER TO ACCOUNT NUMBER AND TRANSACTION REFERENCE NUMBER

THE UNIVERSITY OF TENNESSEE
OFFICE OF THE TREASURER
GENERAL AND SUBSIDIARY LEDGER ACCOUNT

REPORTING PERIOD 7/01/78 TO 09/30/78

RESP PERSON J C MCGIFF FR K U MALIK
DEPARTMENT PHARMACOLOGY
LOCATION 301 CROWE
ACCOUNT NAME USPHS GRANT HL-00142
BUDGET ENTITY CENTER FOR HEALTH SCIENCES
FUND EDUCATIONAL AND GENERAL FUNDS CURRENT RESTRICTED
REPORTING ORG ATTRIBUTES FUND 121-07-30-025-000
COLLEGE MAJ DIV COLLEGE OF BASIC MEDICAL SCI
L/C 51
ACCOUNT NO B07991256
STATUS FINAL
PAGE NO 1
RUN SEQ 6444
RUN DATE 10/12/78

DATE	INTRANSIT NUMBER	TRANS TYPE AND REFERENCE NO	DESCRIPTION	LEDGER ACTIVITY CODE	INTRANSIT DEBIT	INTRANSIT CREDIT	DEBIT	CREDIT	BALANCE
			BEGINNING BALANCE						3,223.33
07318		PV99999999	GENERATED ACTIV	089			2,789.47		433.86
07018		JV 5	REVERSE JV 2489 FY 78	003				7,000.00	7,433.86
			PERIOD BALANCE - 7901				2,789.47	7,000.00	7,433.86
08318		PV99999999	GENERATED ACTIV	089			2,676.92		4,756.94
08318		JV 251	RECEIPT OF AWD	003				35,640.00	40,396.94
			PERIOD BALANCE - 7902				5,466.39	42,640.00	40,396.94
09308		PV 19	RESTRICTED EXP	089			2,500.00		37,896.94
09308		PV 19	RESTRICTED EXP	089			39.41		37,857.53
09308		PV 19	RESTRICTED EXP	089			137.51		37,720.02
09208		DV 242539	RESTRICTED EXPENSE	089			4.20		37,715.82
			ENDING BALANCE				8,147.51	42,640.00	37,715.82

** LEDGER ACTIVITY CODE ANALYSIS **

LAC DESCRIPTION		MTD TRANSACTIONS	INTRANSIT TRANSACTIONS	YTD TRANSACTIONS
GIFTS,GRANTS&BEQUESTS-RECEIPTS	003			42,640.00
COVER RESTRICTED EXPENSE	089	2,681.12-		8,147.51-
TOTAL		2,681.12-		34,492.49

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FIGURE 6.3

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an accounting period and will always be within a few days of being completely current.

Reference has been made previously to the University object code which identifies the object of an expenditure transaction. At The University of Tennessee we have developed a five-digit object code structure that provides for the categorization of an expenditure at three levels: a primary level (the first two digits), a detailed level (the third digit), and optionally, at a user level (the fourth and fifth digits). Each level represents a further subdivision of the preceding level. The primary object codes currently in use are shown in Figure 7.

The budget of the University is currently being formulated at the primary object code level in terms of gross and recovered expenditures. Expenditure transactions require classification at the detailed object code level. Optionally, the user may elect to classify expenditures at the user level. In this system the interpretation of the object codes is predefined to the detail level, but at the user level the last two digits may mean whatever the user desires. This feature can be used, for example, by a department to keep track of travel expenditures by individual within the department or for some other breakdown of a detailed object code unique to the department.

The ledger data base has the provision for storing budget data at any object code level for several fiscal years in the future. This feature is used by the system to support the budget formulation process. Requested budget data for the next fiscal year is entered and iteratively refined throughout the budget process. When the final budget has been determined, it is

FIGURE 7

```
                         REFERENCE 153
                           SCSPROBJ

NAME:     UNIVERSITY PRIMARY OBJECT CODES

NARRATIV: THIS IS A UNIVERSITY DEFINED CODE WHICH
          IS USED TO CLASSIFY THE NATURE OF COSTS
          INCURRED.

COMMENTS: THE CODE SCHEME CONSISTS OF:
          1. A 2-DIGIT REPRESENTATION OF THE
             UNIVERSITY PRIMARY OBJECT CODE.
          2. A 6-DIGIT EFFECTIVE DATE.
          3. AN 8-CHARACTER FIELD RESERVED FOR FUTURE USE
             (FREE SPACE).
          4. A 1-DIGIT REPRESENTATION OF THE UNIVERSITY BUDGET
             CATEGORY (REFERENCE 158) ASSOCIATED WITH THE CODE.
             SINCE THIS CATEGORY IS NOT APPLICABLE TO PLANT
             FUNDS, IT WILL BE SET TO ZERO FOR ALL PLANT FUNDS.
          5. A 2-DIGIT T.H.E.C. EXPENDITURE OBJECT VALUE
             (REFERENCE 156) ASSOCIATED WITH THE CODE.
             SINCE THIS VALUE IS NOT APPLICABLE TO PLANT FUNDS,
             IT WILL BE SET TO ZEROS FOR ALL PLANT FUNDS.
          6. A 1-DIGIT SUMMARY LEVEL BUDGET CATEGORY
             (REFERENCE 169) ASSOCIATED WITH THE CODE.
          7. A 30-CHARACTER TRANSLATION FOR THE PRIMARY
             OBJECT CODE.
          8. A 10-CHARACTER FIELD RESERVED FOR FUTURE USE
             (FREE SPACE).

RSP USER: U.T. TREASURER'S OFFICE

FREQUNCY: STABLE, LITTLE OR NO CHANGE ANTICIPATED.

SOURCE:   FISCAL POLICIES AND PROCEDURES # 3

REFER TO: 156, 158, 169

REFER BY: 157

USAGE:    FINANCIAL

REVISION: DATE OF LAST UPDATE - 05/09/78

     CODE   B/C   THEC   SUM           TEXT
-------------------------------------------------------------

      11     1     11     1    ADMIN & PROFESSIONAL SALARIES
      12     1     12     1    ACADEMIC SALARIES
      13     1     12     1    GTA,GA,GRA SALARIES
      14     1     11     1    PAYMENTS TO RETIRED PERSONS
      15     2     12     1    SUMMER SCHOOL
      16     3     13     1    CLERICAL & SUPPORTING-SALARIED
      17     4     13     1    CLERICAL & SUPPORTING-HOURLY

-------------------------------------------------------------
```

FIGURE 7

REFERENCE 153
SCSPROBJ

CODE	B/C	THEC	SUM	TEXT
18	4	14	1	STUDENT EMPLOYEES
19	5	33	2	NON WAGE PAYMENTS
21	5	21	2	STAFF BENEFITS - REQUIRED
22	5	21	2	STAFF BENEFITS - OPTIONAL
31	5	22	2	TRAVEL
32	5	31	2	MOTOR VEHICLE OPERATIONS
33	5	23	2	PRINTING, DUPLICATING, BINDING
34	5	24	2	UTILITIES AND FUEL
35	5	25	2	COMMUNICATION
36	5	26	2	MAINTENANCE AND REPAIRS
37	5	27	2	PROF SERV & MEMBERSHIPS
38	5	28	2	COMPUTER SERVICES
39	5	28	2	SUPPLIES
41	5	29	2	RENTALS
42	5	29	2	INSURANCE
43	5	32	2	AWARDS
44	5	33	2	GRANTS AND SUBSIDIES
45	5	91	2	MANDATORY TRANSFERS
46	5	27	2	CONTRACTUAL & SPECIAL SERVICES
47	5	92	2	NON-MANDATORY TRANSFERS
48	5	48	2	SERVICE DEPARTMENT CREDITS
49	5	34	2	OTHER EXPENDITURES
50	5	35	2	STORES FOR RESALE
51	5	35	2	STORES FOR RESALE
52	5	35	2	STORES FOR RESALE
53	5	35	2	STORES FOR RESALE
54	5	35	2	STORES FOR RESALE
55	5	35	2	STORES FOR RESALE
56	5	35	2	STORES FOR RESALE
57	5	35	2	STORES FOR RESALE
58	5	35	2	STORES FOR RESALE
59	5	35	2	STORES FOR RESALE
61	6	36	3	EQUIPMENT
62	6	36	3	MINOR EQUIPMENT
63	6	36	3	LIBRARY BOOKS
64	6	36	3	LIVESTOCK
65	5	33	2	INDIRECT COST
71	6	00	3	LAND - CAPITAL OUTLAY
72	6	72	3	BUILDINGS - CAPITAL OUTLAY
73	6	41	3	IMPROVEMENTS OTHER THAN BLDGS
91	0	00	4	LAND - PLANT FUNDS
92	0	00	4	BUILDINGS - PLANT FUNDS
93	0	00	4	EQUIPMENT - PLANT FUNDS
94	0	00	4	OTHER CAPITAL IMPROVEMENTS
95	0	00	4	NON-CAPITAL OUTLAY ITEMS
96	0	00	4	OTHER PLANT FUND EXPENDITURES

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automatically established as the current budget when the fiscal year changes. In addition to storing budget data for future fiscal years, up to five fiscal years of historical data on individual accounts is stored online where it is available for immediate analysis processing.

The final products of the financial/accounting system are the management ledgers and reports. Even though the system is operated and controlled by the Central Administration, access to the Financial Data Base is available at each campus across the State via a remote entry/remote job output facility on each campus. Reports and ledgers processed centrally may be routed electronically to the appropriate campus for printing. In addition to the standard hard copy financial ledgers, all of our ledgers are also produced on microfiche. This eliminated the need for the subsequent microfilming or storage of paper ledgers. Also in the microfiche processing, the expenditure ledgers and the grant and contract ledgers are prepared on a cumulative year-to-date basis. That is, at the end of any given month for an account, the microfiche for that account will contain all the expenditure ledgers for all the preceding months of that fiscal year as well as the current month. This has significantly eased the task of tracing or reviewing the transaction activity on an account for the fiscal year.

V. FUTURE ENHANCEMENTS

The University of Tennessee Financial/Accounting System, like all such systems, is continually evolving and changing. A number of major enhancements and additions to our system are planned in the next few years. The most significant planned change concerns the development and utilization of an online data communication capability in the financial area. To this end, the

University has recently decided to acquire the data communication version of IMS/VS. Our first application system will be an interactive online transaction entry system to supplement our batch system. Other online systems that are planned include an interactive budget preparation system and a number of query systems for the retrieval of purchase order and account balance data.

A second major area of effort will be in the development of a grant management subsystem. The involvement of the University in grants and contracts is continuously expanding. While much grant and contract data is captured and stored in the financial system, our plan is to expand that data base with the objective of automatically performing our indirect cost calculations and invoicing our sponsoring agencies. In addition, we plan a number of financial and non-financial reports for the direct use of our principal investigators in the management of their research grants and contracts.

Other exciting financial applications, such as program costing and modeling, lie in the future. We feel satisfied, however, that with our new financial/accounting system we have succeeded in taking a step in the right direction toward a true University Management Information System.

ON-LINE REGISTRATION USING AN INTEGRATED DATA BASE: THE SOUTHWEST TEXAS STATE UNIVERSITY EXPERIENCE

Michael L. Abbott
Alistair H. Cowe
Southwest Texas State University
San Marcos, Texas

ABSTRACT: This paper addresses the planning, design, development and implementation of an on-line, real-time registration system within an integrated data base environment. It describes a system which consolidates the requirements of the Registrar, Financial Aids, Housing, and Accounting into a single process minimizing the confusion and time required to register a student.

At Southwest Texas State University, a student registers, receives his schedule and itemized bill, and pays fees within 30 minutes. The total time necessary to process the student enrollment of 15,000 is 24 hours (i.e. 3 eight-hour days).

ON-LINE REGISTRATION USING AN INTEGRATED DATA BASE: THE SOUTHWEST TEXAS STATE UNIVERSITY EXPERIENCE

Southwest Texas State University is one of the fastest growing institutions in the State of Texas. Its enrollment has increased 80% in the last decade, from 8406 to 15,072. Like many other institutions, this growth has resulted in a radical change in many administrative operations, particularly the process of registering students for classes. Whereas ten years ago a student would spend an entire day picking up and filling out packets of punch cards, and still not knowing courses for which he was officially registered for 1-2 days; today, in a matter of minutes, the student has registered, paid his fees and received his schedule. Moreover, university administrators no longer have to wait two to three weeks for official registration statistics.

Instrumental in this improvement of the registration process was the upgrading of the computing facilities at SWTSU. In 1968, administrative computer support was provided by an IBM 360/20 with 16K bytes of memory. In July 1975, a DECSYSTEM 1060 replaced the 360/20 as the centralized computer facility for both administrative and academic computing needs. The system configuration of the DECSYSTEM 10 has been modified several times to accomodate student growth and new support areas over the last three years; the current system configuration is outlined in Chart I.

SOUTHWEST TEXAS STATE UNIVERSITY

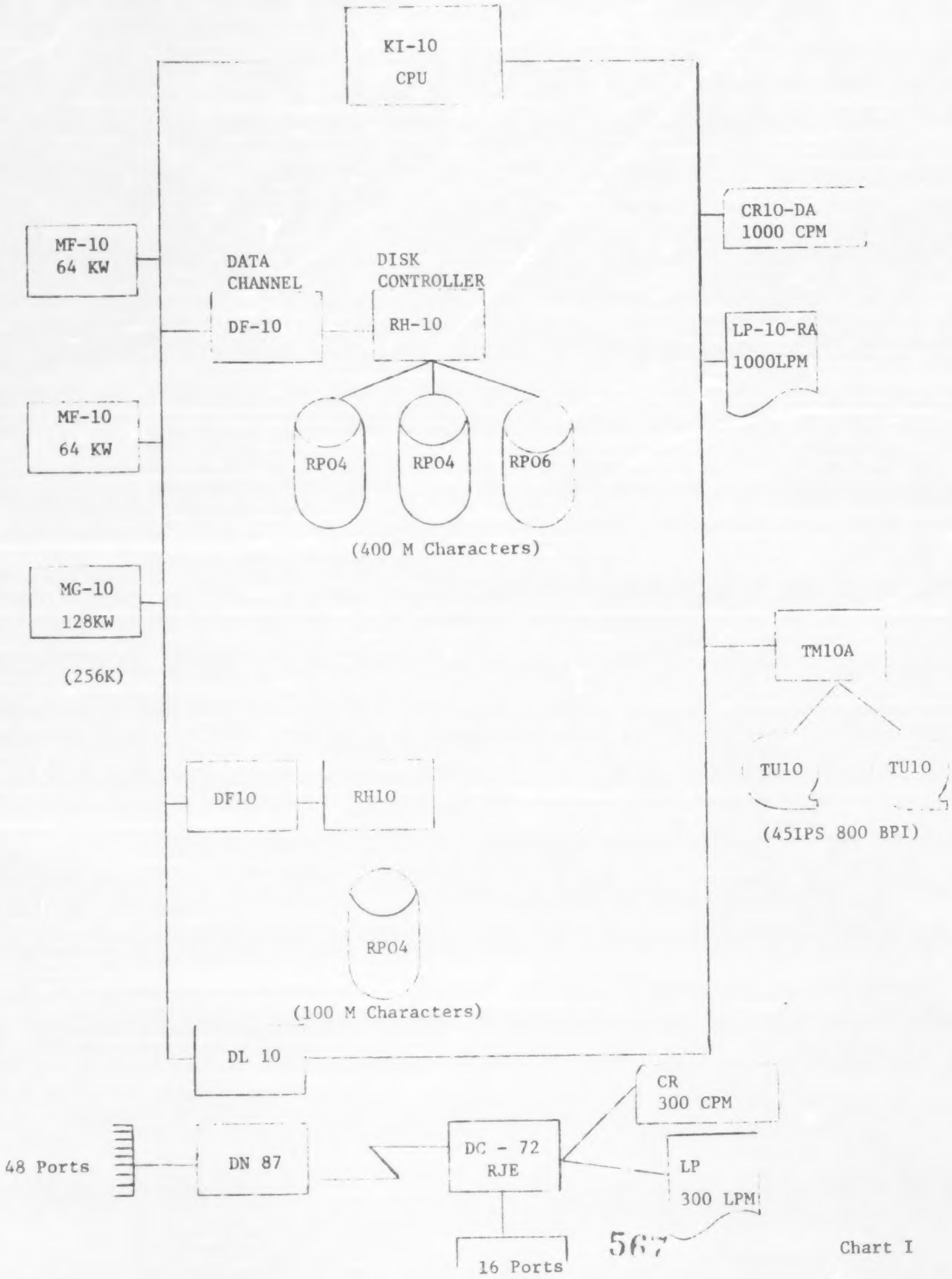

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Chart I

Computing Services at Southwest Texas State University

The increasing importance of computing services and the impact it has on all aspects of a university has resulted in a policy at SWTSU that computing services priorities are regularly reviewed and approved by the Vice Presidents' Council, even though, administratively Computing Services reports to the Vice President for Finance and Management. Moreover, the Vice Presidents' Council annually sets guidelines for the amount of effort provided to each division (i.e. vice president) from the administrative data processing operation. Regular priorities meetings of committees in each divisional area assist ADP staff in determining operational priorities.

Chart II indicates the organizational structure of Computing Services at SWTSU.

Within the area of ADP, three systems teams exist:

1) University Affairs Systems Team -- This group provides systems design and programming support for the following areas:

    a) Registrar's
    b) Admissions
    c) Financial Aids
    d) Residential Living
    e) Library
    f) University Policy
    g) Placement and Counseling
    h) Athletics

2) Finance and Management Systems Team -- This group provides systems design and programming support for the following areas:

COMPUTING SERVICES: ORGANIZATION CHART

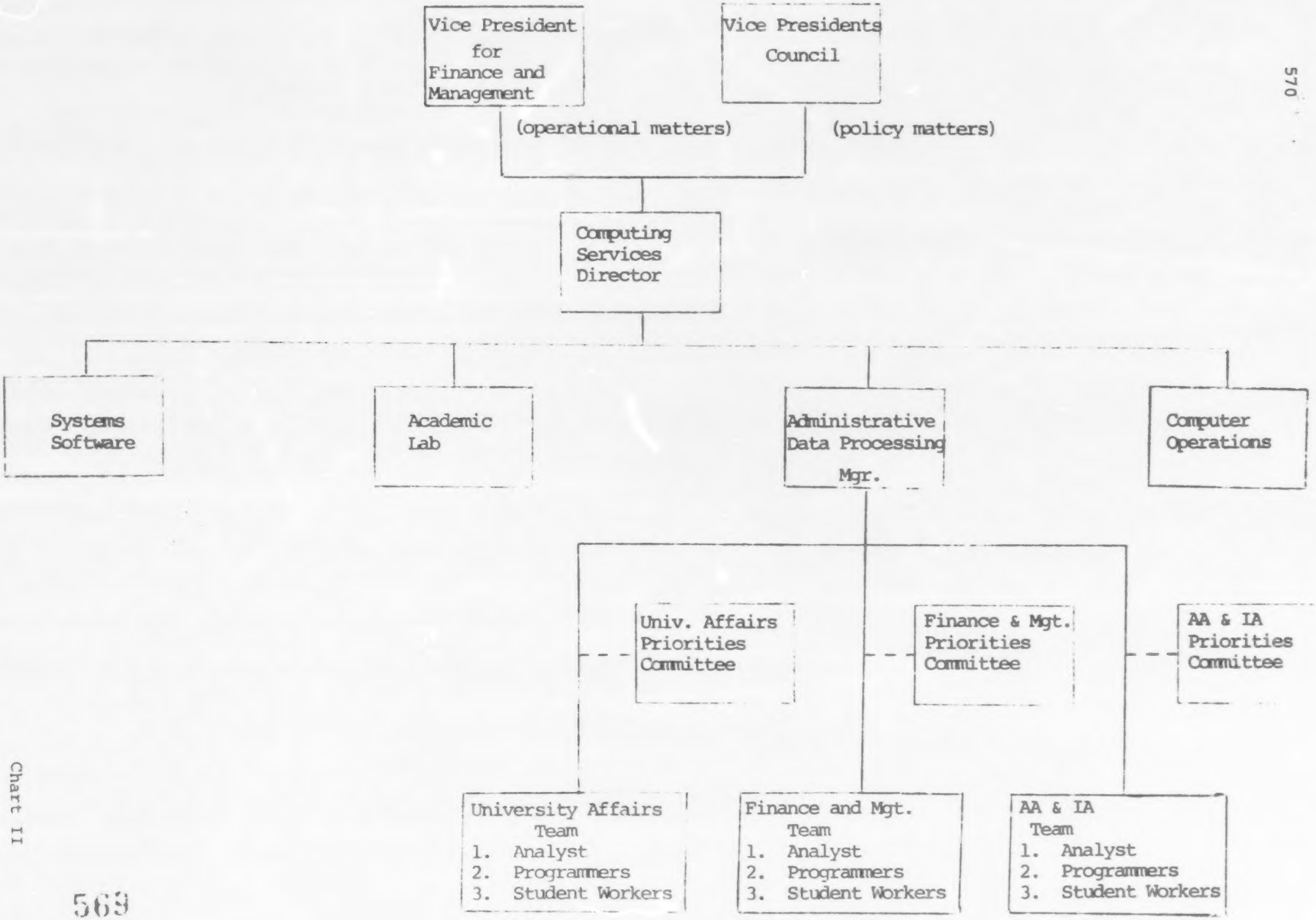


Chart II

a) Accounting
b) Auxiliary Services
c) Physical Plant
d) Personnel
e) Budgeting and Grants
f) Planning and Analysis
g) Purchasing
h) Property Management

3) Academic Affairs/Institutional Advancement Systems Team -- This group provides systems design and programming support for the following areas:

   a) Alumni
   b) Development
   c) Public Service and Continuing Education

Considerations in the Design of an On-line, Real-time Registration System

The events involved in the registration process at SWTSU prior to 1976 were similar to those traditionally found at most institutions. Students in untold numbers appeared for registration on registration day with little, if any information about the process of getting enrolled into specific courses. Too often students ended up wandering aimlessly from point-to-point, attempting to follow loosely defined instructions provided by uninformed experts. The end result was many unhappy students, many frustrated administrators and several ranting programmers.

The installation of the DECSYSTEM 10 provided a unique opportunity for SWTSU to improve the above situation. Recognizing this opportunity, SWTSU officials decided to revamp the entire registration process to provide a system which better met administrative needs for information, and more importantly, allowed students to enroll in classes in a shorter amount of time with much less hassle.

The following goals were established to enhance the registration process:

a. Eliminate the age old "bull pen" image;

b. Eliminate all logistic support areas previously identified as separate entities within the total registration process. The "prima donna" support areas encompassed residential living, financial aids, vehicle parking permits, tuition adjustments, trust funds, administrative academic holds etc.

c. Streamline student flow so that waiting time for registration was reduced and upon completion of registration all attendant functions, (ie. class enrollments, fee-calculations, room and board fees, parking permits and all other special fees), were considered and a class schedule and total bill for all monetary assessments was produced without delay.

d. Provide a real-time capability to produce timely and accurate reporting of all events occuring during the registration process. This included preparation of class rosters, distribution of monies within the accounting system, release of financial aid monies during or immediately following the registration process and insuring that companion information was immediately accessible for both administrative and academic use.

Description Of The On-Line Registration System

File Descriptions

There are nine major files directly or indirectly associated with the Southwest Texas State University registration system. These files include people file, inventory to courses file, class section file, class enrollment file, receipt file, financial aid file, master code file, trust file, and tuition adjustment file (see figure #1).

People File

This file contains a record for each individual associated with SWTSU, including students, faculty, staff, library patrons, financial aid, housing, or admission applicants. The file contains demographic data necessary to identify the current status and the indicative data for all individuals. The People File is the nucleus of the data base; any activity pertaining to or required for University actions, either academic or administrative, is valid only upon entry of the individual into this file. File discipline is random. This file is accessed through the Social Security Index, the Name Index, or through links from other contingent files.

Inventory Of Courses File

This file contains a record for all courses ever taught at SWTSU. Data elements for this file reflect department/course number, course description, type of instruction, prerequisite codes, classification codes, special fee codes, and all other

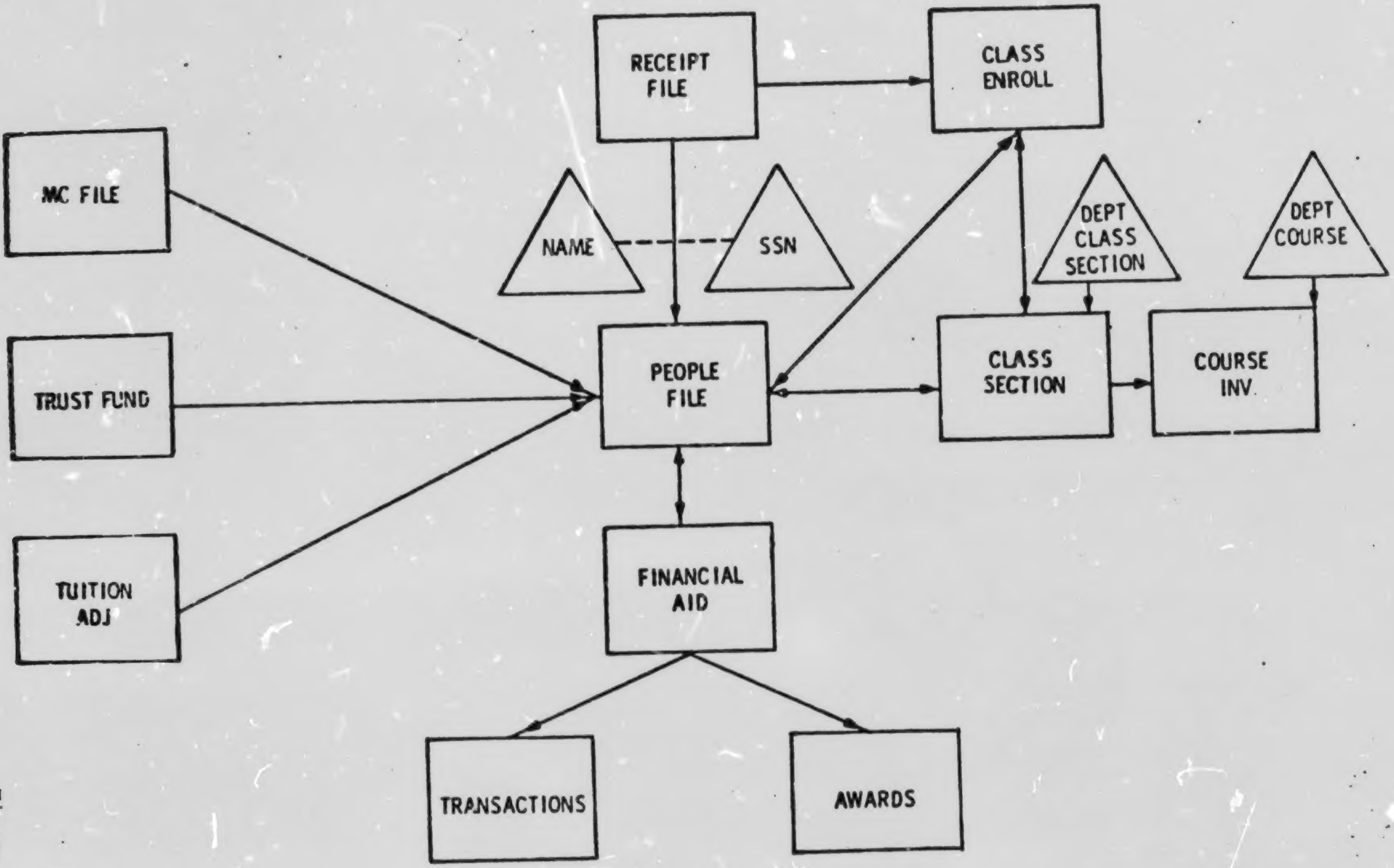

RECEIPT FILE
CLASS ENROLL
MC FILE
NAME
SSN
DEPT CLASS SECTION
DEPT COURSE
TRUST FUND
PEOPLE FILE
CLASS SECTION
COURSE INV.
TUITION ADJ
FINANCIAL AID
TRANSACTIONS
AWARDS

Figure #1

related codes for reporting to state/government agencies. File discipline is random. This file is accessed through the department course index, and record links from the Class Section and Transcript files.

Class Section File

This file contains a record for each course/section taught within a current semester. Data elements for this file reflect department/course/section, building room number, time class meets, maximum capacity of section, and type of instruction. File discipline is random. This file is accessed through the Class Section Index and record links from the People File and Class Enrollment file. The file contains People File pointer, Class Enrollment pointer, and the Inventory of Courses pointer. Records within this file are chained by instructor.

Class Enroll File

This file contains one record for each class in a student's schedule within a current semester. Data elements for this file reflects department, course, section, grade and status of record. File discipline is random. This file is accessed through record links from the People File, Receipt File, and the Class Enrollment File. Records within this file are chained by section and by student.

Receipt File

This file contains records reflecting transactions affecting tuition fees paid by students. Information is distributed by type of fees paid. Specific categories are tuition, dormitory, parking permit, building use, and other categories of payment required by student during or following the registration cycle. The file is random with the receipt number being the actual key and is accessed through the People File.

Financial Aid File

This file contains a single master record for each student for each base year. Each record contains information required to determine financial need and eligibility and is accessed through the People File. File is indexed sequential and contains links to the People File, Award File, Loan Account File, and where applicable, to prior and new master records.

Master Code File

This file contains general purpose code tables frequently used. These tables consist of ZIP code and City State spellouts. Dormitory codes and companion fees associated with dormitory, lab courses fees when applicable and other frequently used information. File is indexed sequential and is a stand-alone file accessed usually from applications programs using a standard copy routine.

Trust Fund

This file contains a single record for each remittance received from individuals as deposits. Types of deposits are categorized: Dormitory, Property, Library, and Other. File is indexed sequential.

Tuition Adjustment File

This file contains a record for each student who has tuition adjustment entitlement. This file is used to determine credit application for student registration and is constructed each semester. File is indexed sequential.

Pre-Registration Tasks

The basic essentials of the Southwest Texas State University registration system do not differ significantly from other institutions. As might be imagined, all actions affecting the registration of first-time students begins with the submission of an application for admission. This application contains the usual elements necessary to provide information for enrollment viz, Social Security number, Name, Address, Phone, Religion, Ethnic category, Sex, Date of Birth, etc. A reproduction of the application form is reflected in figure #2. Data from the application form is keyed into the People File where a permanent record is established. From this record, we prepare the actual registration form.

Registration Form

Registration forms are produced and distributed prior to the actual day of registration or on occurrence for walk-in students. Data for the registration form is extracted from the People File (Figure #3). During the preparation of forms, a time and date to register is selected, using the last two digits of the social security number. In addition, any factors limiting the registration of a student such as traffic fines, financial obligations, admissions holds, financial aid holds, library overdues, etc., are printed so that the student can resolve difficulties prior to enrolling. The design of the registration form allocated data lines to print necessary information as well as providing a blank line to allow students to enter corrections.

SOUTHWEST TEXAS STATE UNIVERSITY

580

Application for Admission

(Undergraduate and Post Graduate only)

Southwest Texas State University welcomes your application for admissions. To be granted Final Acceptance, all applicants must meet the requirements of their admission program. Fill out this application, fold, and return to the Director of Admissions. Final Acceptance, an SWT catalog of courses and orientation/registration information will be sent to each applicant accepted.

Check the appropriate Admissions Program

____Beginning Freshman
____Transfer
____Former Student Re-entry

____Transient
____Post Graduate
____Early Admissions

____AAAP (Accelerated Achievers Admission Program)
____Individual Approval (Circle one Veteran, Extension, GED, Continuing Ed., International Student, Special Projects.)

Term applying for. ____Fall 19____ ____Summer I 19____ (First Six Weeks)
____Spring 19____ ____Summer II 19____ (Second Six Weeks)

PERSONAL DATA:

SSN____________ Name ____________________
Last First Middle Maiden

PERMANENT ADDRESS ____________________
Street & Number City County Country State Zip

BIRTH DATE____________ MARITAL STATUS____________ SEX____________
Month Day Year Single Married Male Female

If you are single, provide information on your parent (if living) or legal guardian. If you are married, provide information on your spouse.

NAME____________________ TELEPHONE NO (__) ______ __
First Middle Last

ADDRESS ____________________
Street City State Zip Occupation

EDUCATIONAL DATA:

PROPOSED MAJOR____________ PROPOSED MINOR____________

HIGH SCHOOL GRADUATED FROM ____________________
Name City State

GRADUATION DATE
Month____________ Year____________

YEARS ATTENDED
19________ to 19________

Accredited institutions attended. An official transcript must be submitted from each college attended. Failure to list institutions previously attended may result in dismissal from SWTSU.

NAME OF INSTITUTION	STATE	FROM MONTH/YEAR	TO MONTH/YEAR

NAME OF COLLEGE CURRENTLY ATTENDING ____________ SEMESTER ____________

TOTAL NUMBER OF HOURS ATTEMPTED____________ DEGREES COMPLETED ____________
DATE

DO NOT WRITE IN THIS SPACE

County ______
HS Code ______
Degree ______
Major ______
Minor ______
Level ______
Org Boa ______
Col T ______
Col Td ______
Immunization ______
ACT ______
Tui ______
Eth ______

RESIDENCY STATUS:

Have you resided in the state of Texas (other than as a college student) for the past 12 months? ____Yes ____No

Have your parents, guardian or spouse resided in Texas for the past 12 months? ____Yes ____No

If you answered no to either question, obtain additional information from the Admission Office for verification of your residency status.

I certify that I qualify for ______Texas Resident Fees
______Non Resident Foreign Student Fees

ETHNIC ORIGIN (Required for State and Federal Reports) (Used for HEW reports only.)

White (Non Hispanic)
Black (Non Hispanic)
American Indian or Alaskan
Hispanic

__ Asian or Pacific Islander
__ Non Resident alien Foreign National
Other

Figure #2

REGISTRATION FORM

NAME BOEHM, BONNIE R
SOCIAL SECURITY NO 467-35-5572
SEMESTER SUMMER 2 '77

Southwest Texas State University

YOUR TIME TO REGISTER
581
07/08/77 3:30 PM

IF LINE A IS INCORRECT, MAKE CORRECTIONS ON LINE B. SEE BACK OF REGISTRATION FORM FOR CODES AND ADDITIONAL REGISTRATION INFORMATION. IF LINE A IS BLANK, SUPPLY INFORMATION ON LINE B.

A	,				F	S
	Address While Attending SWTSU	Zip	Phone	Class	Sex	Marital Status
B						

A	100	100		7/30/59	1				1	B
	Major	Minor	Pre-Prof	Date of Birth	Ethnic Origin	Teach Cert	Veterans Benefits	Financial Aids	Residency	Basis of Admissions
B							▨	▨	▨	▨

A	P O BOX 121, SHINER TX	77984			
	Permanent Home Address	Zip	Phone	Either Parent Attend SWSTU	Religious Prefer
B					

A	EDWIN A BOEHM	P O BOX 121, SHINER T	77984	512/594-2323
	Person to Notify in Emergency	Address	Zip	Phone
B				

NAME BOEHM, BONNIE R
SOCIAL SECURITY NO. 467 35 5572

SPACES BELOW TO BE CODED BY UNIVERSITY PERSONNEL ONLY

Cand. for Grad	Auto		Motor Cycle	Housing Code	Room fee	Board fee	Lone occ			
	Campus	Satellite								
A	B	C	D	E	F	G	H	J	K	L

582

DEPT APPROVAL

FINAL CHECK

Figure #3

Course Labels

Course labels for class enrollment are produced prior to registration and are provided to academic departments for distribution. These labels are prepared in predetermined quantities as identified by the class capacity reflected in the class section record. In addition to course labels, quantities of drop and spare labels are produced, the quantities of drops and spares are computed by an arithmetic algorithm, using the class maximum as the base. A minimum of eight drop labels are procuded for all sections. (Figure#4) The most significant indicator of the class section label is the index number. This number is the actual key to the Class Section File and is used during the registration process as the single data entry identification item to register for courses. The index number provides the key to retrieval of Department/Class/Section, Course Description, Teacher Name, location of class and time of class meeting. Figure #5 provides an explanation of all data items contained in the course label.

```
IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                       2  <1805> TRUE                       3  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                       4  <1805> TRUE                       5  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                       6  <1805> TRUE                       7  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                       8  <1805> TRUE                       9  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      10  <1805> TRUE                      11  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      12  <1805> TRUE                      13  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      14  <1805> TRUE                      15  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      16  <1805> TRUE                      17  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      18  <1805> TRUE                      19  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      20  <1805> TRUE                      21  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      22  <1805> TRUE                      23  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      24  <1805> TRUE                      25  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      26  <1805> TRUE                      27  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      28  <1805> TRUE                      29  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      30  <1805> TRUE                      31  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      32  <1805> TRUE                      33  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      34  <1805> TRUE                      35  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      36  <1805> TRUE                      37  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      38  <1805> TRUE                      39  <1805>

IA    1330  ,001 TTH      0800-0930  IA    1330  ,001 TTH      0800-0930
TRUE                      40  <1805> TRUE                      41  <1805>
```

Figure #4

COURSE LABEL

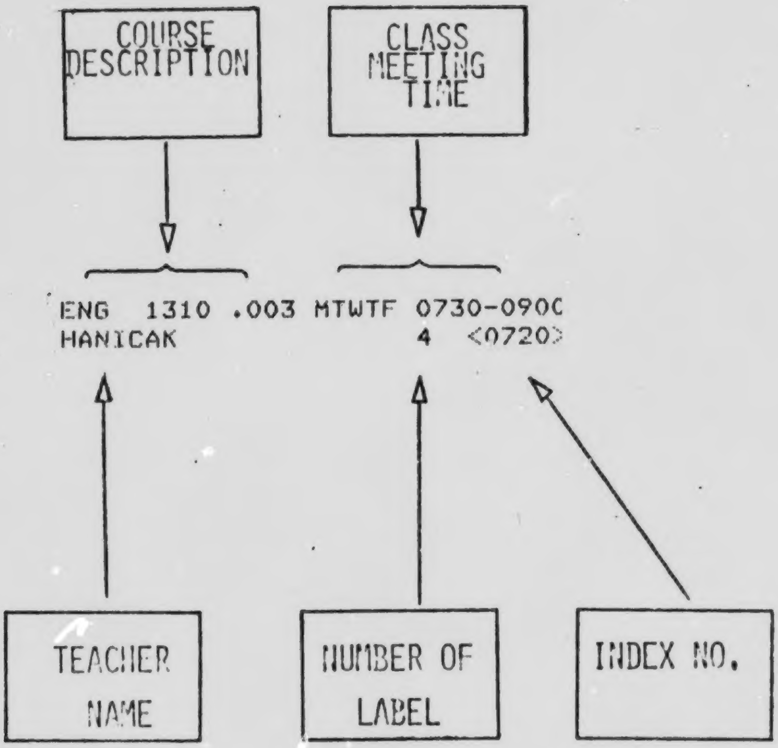


Figure #5

Registration of Students

At the appointed time, students report to the registration area and gain admission by presenting the registration form. Door attendants check time elements and permit access (if the access time is current or has passed). Students then process through the academic departments and retrieve the necessary labels for course enrollments. Department representatives affix course labels to the lower protion of the registration form (Figure #6). Since labels are numbered to correspond to class capacity, a current total of seating spaces is always available. When all course labels are completed, the student obtains departmental approval from the authorized representative from the department of a student's major.

Follow-on processing encompasses the identification of candidates for degree, purchase of parking permits with options of coverage for one semester, academic year, automobile, motorcycle, on-campus or commuter parking. Housing and board, with payment options predicated upon one or two installments, a meal plan without room, five-day meals or seven-day meals are also obtained at this point. These activities are attended by personnel from the appropriate functional areas who enter the information (options) on the appropriate blocks of the registration form. (Figure #6)

Upon completion of the above processes, the student reports to the terminals for entry into the system. Physical environment of the typical data entry peripheral setup is depicted in figure #7.

Perhaps the most attractive feature of the SWTSU registration system is the ability to quickly reconfigure peripheral devices to adjust to student flow. This is accomplished by using DECSystem's utility program, "OPSER" where all registration programs are run as "sub-jobs" from one terminal. This facilitates job control and provides a single source for job monitoring.

REGISTRATION FORM

NAME CAMPBELL, JAMES E
SOCIAL SECURITY NO 454-13-0839
SEMESTER SU F 2 1977

Southwest Texas State University

YOUR TIME TO REGISTER
07/05/77 10:00 AM

A TRAFFIC FINES HOLD EXISTS ON YOUR RECORD - ASS'T BUSINESS MANAGER'S OFFICE.

IF LINE A IS INCORRECT, MAKE CORRECTIONS ON LINE B. SEE BACK OF REGISTRATION FORM FOR CODES AND ADDITIONAL REGISTRATION INFORMATION. IF LINE A IS BLANK, SUPPLY INFORMATION ON LINE B.

A	309 PECAN PARK, SAN MARCOS TX	78666	392-8075	3	M	S
	Address While Attending SWTSU	Zip	Phone	Class	Sex	Marital Status
B						

A	141	324		12/08/55	1				1	P
	Major	Minor	Pre-Prof	Date of Birth	Ethnic Origin	Teach Cert	Veterans Benefits	Financial Aids	Residency	Basis of Admissions
B							▨	▨	▨	▨

A	110 CENTER ST ,BAYTOWN TX	77520			K
	Permanent Home Address	Zip	Phone	Either Parent Attend SWSTU	Religious Prefer
B					

A	FRANCIS DARR CAMPBELL	110 CENTER ST, BAYTOWN	77520	000/000-0422
	Person to Notify in Emergency	Address	Zip	Phone
B				

NAME CAMPBELL, JAMES E

SOCIAL SECURITY NO 454 13 0839

SPACES BELOW TO BE CODED BY UNIVERSITY PERSONNEL ONLY

Cand for Grad	Auto Campus	Auto Satellite	Motor Cycle	Housing Code	Room fee	Board fee	Lone occ				
B A	1 B	C	D	07 E	2 F	4 G	H	J	K	L	

SPAN 2320 ,002 MTWTF 1050-1220
TERRAZAS 35 <0382>

HIST 1310 ,004 MTWTF 0910-1040
JAMISON 30 <0113>

PHYS 1440 ,003 MWF 1100-1150
JACKSON 4 <0676>

GEO 4380 ,001 ARR -
HARRISON 4 <0007>

PHYS 1440 ,L01 TUE 0200-0350
STAFF 11 <0677>

588

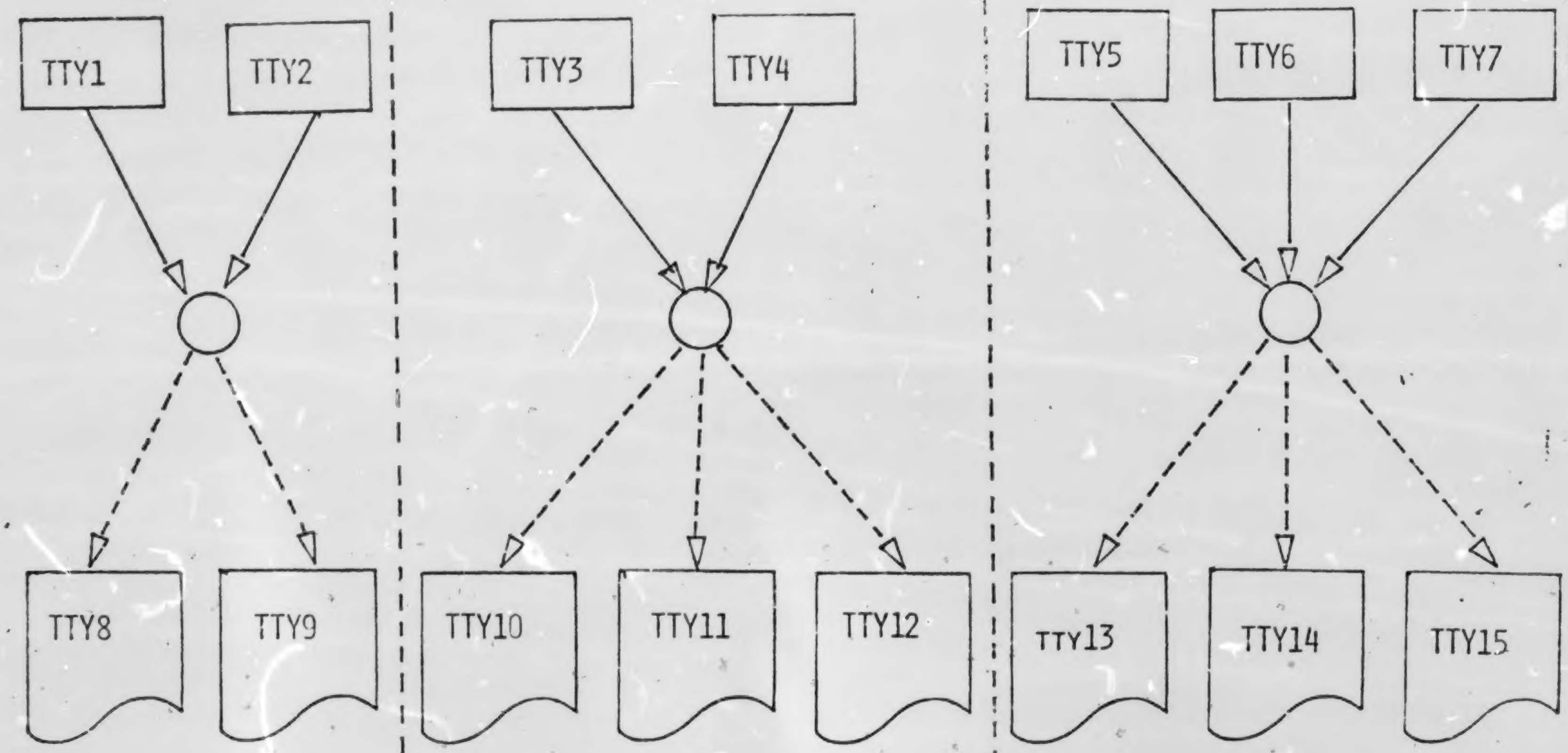
PSY 2310 ,001 MTWTF 0730-0900
HARDESTY 149 <0507>

DEPT APPROVAL

FINAL CHECK

Figure #6

TYPICAL REGISTRATION CONFIGURATION



TOTAL INPUT TERMINALS = 7

TOTAL OUTPUT TERMINALS = 8

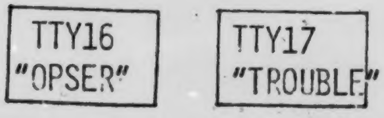


Figure #7

Programs used for the registration process (Figure #8) consist of a data entry program which edits and captures information using the data base file structures. The initial entry program (DRGORG) edits input data and validates course entry information, identifies time conflicts, enrollment in labs without lecture and vice-versa, enrollment of undergraduate students in graduate level courses, and prohibits the registration of any student with a hold condition. In addition, this program creates and passes individual files to the calculate program.(DRGURG) As implied, the calculate program accesses the table codes and determines fees for courses, labs, special fees, parking permits, and room and board fees. The program also considers any credits originating from tuition adjustments or financial aids, enrolls students in courses, creates a receipt record which distributes monies for fees, permits, special fees, building use, tuition, room and board within the receipt record, and finalizes the process by providing an individual print file for the print program.(DRGPRG) Since the output print file is self explanatory, attention is invited to figure #9, which depicts the content of the registration receipt. Essentially, the three programs outlined above are the major programs to complete a registration.

REGISTRATION SYSTEM

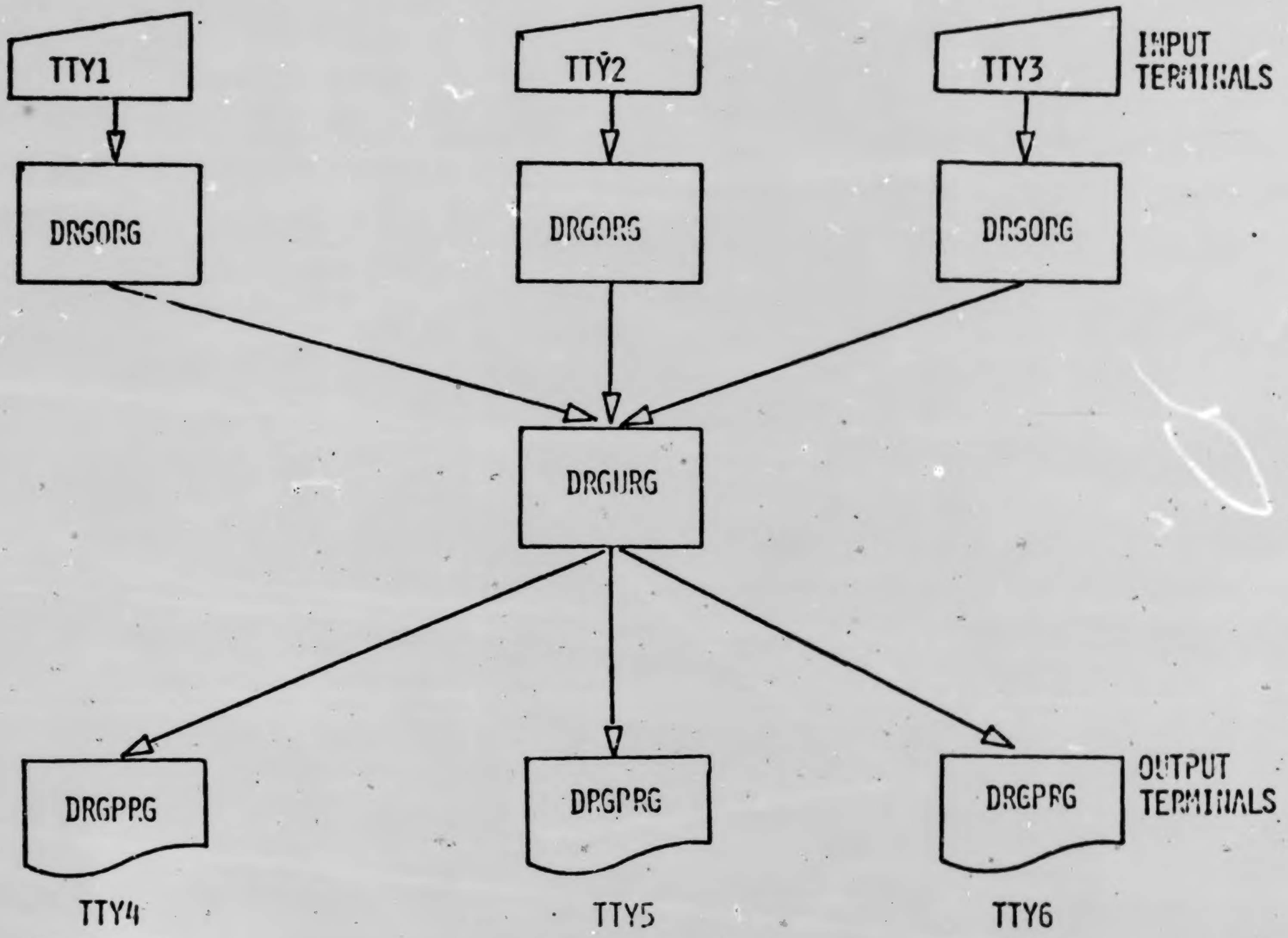
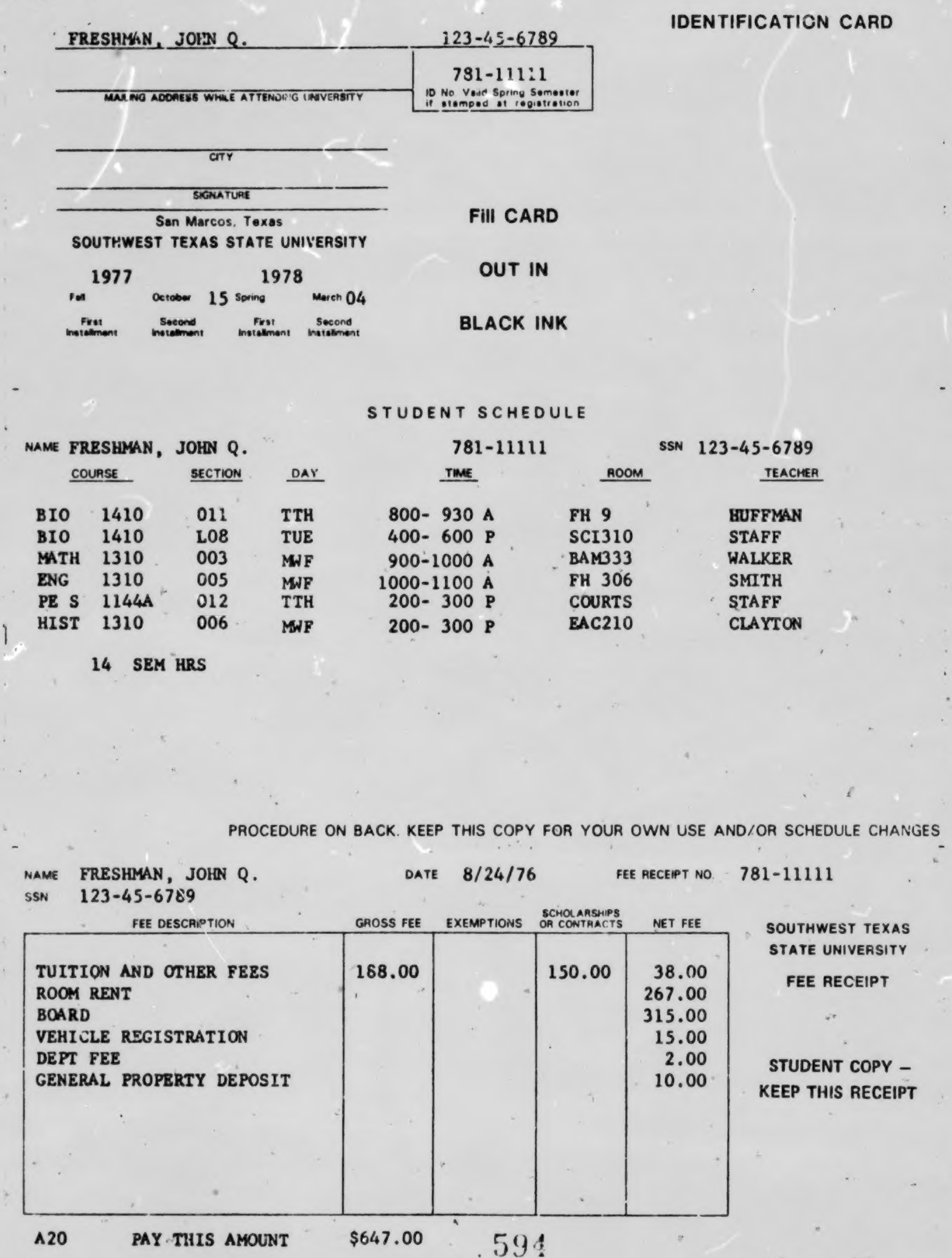


Figure #8



IDENTIFICATION CARD

FRESHMAN, JOHN Q. 123-45-6789

781-11111
ID No. Valid Spring Semester if stamped at registration

MAILING ADDRESS WHILE ATTENDING UNIVERSITY

CITY

SIGNATURE

San Marcos, Texas
SOUTHWEST TEXAS STATE UNIVERSITY

1977		1978	
Fall	October 15	Spring	March 04
First Installment	Second Installment	First Installment	Second Installment

FIll CARD

OUT IN

BLACK INK

STUDENT SCHEDULE

NAME FRESHMAN, JOHN Q. 781-11111 SSN 123-45-6789

COURSE		SECTION	DAY	TIME	ROOM	TEACHER
BIO	1410	011	TTH	800- 930 A	FH 9	HUFFMAN
BIO	1410	L08	TUE	400- 600 P	SCI310	STAFF
MATH	1310	003	MWF	900-1000 A	BAM333	WALKER
ENG	1310	005	MWF	1000-1100 A	FH 306	SMITH
PE S	1144A	012	TTH	200- 300 P	COURTS	STAFF
HIST	1310	006	MWF	200- 300 P	EAC210	CLAYTON

14 SEM HRS

PROCEDURE ON BACK. KEEP THIS COPY FOR YOUR OWN USE AND/OR SCHEDULE CHANGES

NAME FRESHMAN, JOHN Q. DATE 8/24/76 FEE RECEIPT NO. 781-11111
SSN 123-45-6789

FEE DESCRIPTION	GROSS FEE	EXEMPTIONS	SCHOLARSHIPS OR CONTRACTS	NET FEE
TUITION AND OTHER FEES	168.00		150.00	38.00
ROOM RENT				267.00
BOARD				315.00
VEHICLE REGISTRATION				15.00
DEPT FEE				2.00
GENERAL PROPERTY DEPOSIT				10.00

SOUTHWEST TEXAS STATE UNIVERSITY

FEE RECEIPT

STUDENT COPY — KEEP THIS RECEIPT

A20 PAY THIS AMOUNT $647.00

Figure #9

Information for data entry is reduced to one contiguous string of information with each element delimited by a comma. This information is extracted directly from the registration form. The actual data for registration is reflected in Figure #10. Noting the brevity of information, it is obvious to see the great benefit derived in the ease of training data entry personnel. Student workers are used for data entry. Preparation, training and instructions for data entry personnel is usually accomplished in approximately fifteen (15) minutes. With this entry system, we do not require any experienced people resources.

A most significant advantage of on-line registration is the reduced processing time required for registration. Figure #11 reflects the average process time (for a regular long semester) for student registration after input at the terminal. Time element is determined on the basis of the output receipt and represents the elapsed time from completion of printing one receipt until completion of a second receipt on one output device.

Personnel requirements for support of data processing actions have been significantly reduced. The entire professional staff is no longer required to oversee registration. Normally, no more than two professionals are required at any single time period, and these individuals are used primarily to resolve student problems requiring update of data base files. Figure #12 reflects normal manning resources for registration.

454136839, 382, 113, 676, AB, B1, E07, F2, G4

Figure #10

PROCESSING LOADS
FALL/SPRING SEMESTERS

DAILY AVERAGE LOAD:	4200	MAX CAP.	5600
HOURLY AVERAGE:	466	MAX CAP.	700
AVERAGE PROCESS TIME:	1:10SEC	MAX CAP.	42SEC

Figure #11

REGISTRATION MANNING

DATA ENTRY	6	(STUDENTS)
FORM DISTRIBUTION	5	(STUDENTS)
DATA PROCESSING	2	(FULL TIME EMPLOYEES) TROUBLE TERMINALS 2

Figure #12

Future Considerations

SWTSU is currently in the process of developing future enhancements to the current system. The primary modification being made is that of creating a continuous registration cycle. This process will allow (1) concurrent registration for several semesters into the future, (2) courses to begin and end at any time during the year, and (3) improved resource planning for the university. It is envisioned that this continuous registration system will be operational within two years.

TRACK IV
SMALL COLLEGE INFORMATION SYSTEMS

Coordinator:
Paul J. Plourde
SUNY/Potsdam

Wayne Reynolds
Middlesex County College
New Jersey

Raymond E. Whiteman
Spring Arbor College, Michigan

INTRODUCTION TO THE SMALL COLLEGE TRACK

Dr. Paul J. Plourde
Professor and Chairman
Department of Computer and Information Sciences
State University College
Potsdam, New York

As the track coordinator for the small college track, I thought I would give you some insight into what was planned for those of you who plan to attend some of the sessions in this track. We have several presentations that really highlight the different options that are available to small colleges.

One possibility is participation in a consortium and we have two examples of this on the program; one is Babson College and the other is the Associated College of Central Kansas.

Another possibility is the use of mini-computers and either develop all of your own software or use some vendor supplied software and develop some systems which are used in conjunction with that software. The latter is the approach utilized at Babson College which used WISE as a basis for their own development of an integrated on-line information system for student processing.

An example of totally "home grown" software will be explored by Wayne Reynolds who will describe the evolution of CAMEO, a system developed at Middlesex County College in New Jersey.

Yet another option, is the use of a mini-computer and contracting with a commercial firm to have software developed specifically for your institution's use. President George Traicoff of North Shore Community College will describe the efforts of his institution and the other community colleges in Massachusetts which have contracted with Arthur D. Little Inc. (represented by Mr. Kenneth Rodgers) to develop and implement such systems.

Another approach is to use proprietary software and my session will explore the questions that an institution should evaluate when considering such systems. In addition, my session will review the hardware, software, and cost data for six systems as follows:

1. INFO - College Service Corporation
2. INTERACT - Information Associates Inc.
3. MSL/CAMPUS - Mini-Computer Sales & Leasing Inc.
4. POISE - The Poise Company
5. QDMS - Educomp Corporation
6. SOARS - Chama Corporation

The experience of four colleges (universities) that have decided to acquire and implement some of these systems will be presented. The systems and colleges are as follows: INTERACT - Union College, MSL/CAMPUS - University of Chicago, INFO - Spring Arbor College, and QDMS - CMC Colleges Associated.

Finally, Dr. Groff and Mr. Fox of North Central Technical College will consider the application of these various approaches to institutional concerns in their wrap-up session on "Data as an institutional Resource in a Planning Management and Evaluation System."

PROPRIETARY MIS SOFTWARE SYSTEMS

Dr. Paul J. Plourde
Professor and Chairman
Department of Computer and Information Sciences
State University of New York
College at Potsdam
Potsdam, New York

This paper identifies the software currently available from third parties which purport to provide an MIS capability. The available systems will be summarized and the systems available from the following vendors will be introduced: CHAMA Corporation (SOARS), College Service Corporation (INFO), EDUCOMP (QDMS), Information Associates Inc. (INTERACT), Minicomputer Sales and Leasing Inc. (MSL/CAMPUS), and The Poise Company (POISE). A number of evaluation questions, which the author would urge be asked by prospective users, relating to cost, hardware, software, terminals, and security will be discussed.

INTRODUCTION

Since the advent of computers and their subsequent use for administrative data processing, professionals in the field have been searching for ways to minimize the cost and length of time required to develop and implement administrative systems. Some of these attempts have focused on sharing systems, programs and/or concepts. In the higher education sector, this attempt to share has centered around CAUSE and the systems exchange library.

It is safe to say that the attempt by institutions both large and small to implement systems developed for or at another institution have not been entirely successful. The exchanges that have taken place have for the most part been at the conceptual level and institutions have been left without a satisfactory solution to the seemingless endless cost of developing systems.

In recent years, there have been a number of commercial firms that have recognized the dilemma faced by colleges and universities (especially those with limited budgets) to implement meaningful systems in a timely and cost-effective manner. The approach that these firms have taken is to develop systems that purport to provide an institution with a wide range of application systems in more or less a "plug-in" implementation mode. As will be noted below, there is a wide variance in the systems that have been developed but, for the purposes of this paper, these systems will be referred to as management information systems (MIS).

THIRD PARTY MIS SYSTEMS

The objectives of this paper are to review the hardware and software characteristics and the cost of six third party MIS systems, and to provide a number of questions that this author would urge be asked when evaluating such systems. The six systems are as follows: INFO, INTERACT, MSL/CAMPUS, POISE, QDMS, and SOARS.

The primary question that must be asked initially is whether or not the institution wishes to have a combined center for academic computing and administrative data processing. This is a particularly crucial question for small colleges since many of them cannot afford to purchase or lease two computers. The answer to this question will limit your choices since not all of the available systems support academic as well as administrative computing.

Secondly in the way of introduction, I would say that the old addage does apply "You get what you pay for." If you are paying $8,000 for a product, don't look for a comprehensive system with a lot of support because that firm is in business to make money. If you pay $80,000 for a product, you might get some support and a more comprehensive system. Cost then, while of considerable import, should be evaluated in terms of capabilities and their relation to your needs.

In terms of the cost for the specific systems that I am reviewing, the figures that I am quoting are approximations and they are modular. Specific information concerning costs should be obtained from the vendors of the various products. They are in the software market and my purpose is to give you an idea of the systems that are available and you can decide for yourselves which of these systems you would like to investigate further.

When I first thought of writing this paper, I was going to provide a checklist of the system characteristics of each package, but I quickly decided that was next to useless. Just to indicate that the INTERACT system provides for financial accounting, personnel/payroll, budgeting, admissions, student records and billing is not terribly useful and could be misleading. The actual capabilities of these systems vary widely and they require close investigation. Moreover, the systems capabilities are only meaningful when evaluated in terms of your specific needs. Furthermore, since the systems are modular, you may decide that a specific application system is suited to your needs but you may also wish to develop companion systems on your own.

In describing the six available software systems, I have chosen to represent them in terms of a model system. The model assumes that all of the components of each system as marketed by the vendor are used and the specifics of these models are contained in ATTACHMENT A.

INFO - COLLEGE SERVICE CORPORATION

This system, which previously was called SIMS, uses DATAPOINT hardware. It will run on a computer as small as a 1500 which costs $6,000. Clearly you cannot do all the administrative data processing for even a college of 500 students on a $6,000 computer so what I have quoted here is a 5500 system which would run all of the software for that type of institution. The cost of this hardware would be approximately $60,000 and it is certainly possible to upgrade the system. As you will see, when I look at the questions that one should ask when evaluating these systems, upgradeability is one of the important items that have to be considered.

In terms of upgradeability, Datapoint has announced the ARC system during the last year. This system provides the capabilities of a distributed system and will undoubtedly allow users of INFO to combine the academic and administrative computing systems that was not previously possible.

The operating system is something called DOS not to be confused with IBM DOS. The language is DATABUS. I have never heard of DATABUS either and this is also an important consideration since, as will be noted below, language portability from hardware vendor to vendor may well be required.

The cost of the software is $50,000 and that's for the entire package. If you are selecting various components, the price will obviously be less. From a hardware/software cost standpoint, one feature of the INFO approach which is nice is that you can actually buy a small system, install it in the admissions office, and just use the admissions module. The computer might cost you $6,000 and the admissions system module will cost $5,000. You can perform a very specific job for a relatively low cost. This approach could be followed in a number of functional areas and at some future time the systems could be integrated with little difficulty by upgrading the hardware.

A problem with this approach is that it does not currently support academic computing. With the advent of the ARC system, multiple processors can be installed. One or more processors could be used for academic computing and one or more processors could be used for administrative computing. However, the way the system was initially configured with 1500-5500 systems, it was not possible.

INTERACT - INFORMATION ASSOCIATES INC.

The INTERACT system is currently implemented on the HARRIS family of computers. One of the major advantages of this approach is the hardware flexibility provided by HARRIS. The HARRIS line starts with a fairly small computer (not as small as a $6,000 DATAPOINT) but you can install an $80,000 HARRIS system and you can have almost unlimited growth to the point that you have a machine with the power of an IBM 148. With their new announcements, the 500 may even equal the power of an IBM 158. I indicated an S115 as a typical small system for my model and this system would cost approximately $140,000. It is certainly upgradeable by virtue of what was described above.

The operating system for the HARRIS systems is VULCAN and my investigations and reports from consulting clients are very positive. The software is written in COBOL. From my perspective, this feature is a tremendous advantage when compared to the other systems. This is not to say that COBOL is the ultimate language but, as a pragmatist, the fact that it is readable, self-documentating and, more important, vendor independent, is a vital concern. It is not my intended position to make negative comments about any of these systems. However, if you select a system that is written in a language that is not transferable and if you change your mind about the hardware, where are you. Thus, you need to look at portability very carefully.

The cost of INTERACT is approximately $80,000, I don't know if that is fixed yet, since the system was just announced. This is the cost for the full package which includes subsets of the application systems that IAI has marketed for the past 10 years. These systems are well known, they have stood the test of time and that certainly is a feature to consider.

MSL/CAMPUS - MINI COMPUTER SALES & LEASING INC.

This system uses the MICRODATA/REALITY computer series although reports indicate that it will soon be available for the MICRODATA/ROYALE series. At present the software cannot be used with other vendors hardware or other series in the MICRODATA line. The cost of a base system could be as low as $80,000 but the model system is $140,000 which puts it in a class with HARRIS.

The cost for the MSL/CAMPUS software is $60,000 and the system is written in DATA BASIC and ENGLISH which is a high level language available from MICRODATA. The operating system is called REALITY and this is also peculiar to MICRODATA.

Presently, the MSL/CAMPUS-MICRODATA system will only support administrative data processing. Thus, potential users must consider the impact of having a separate computer for academic computing.

QDMS - EDUCOMP CORPORATION

This system uses the Digital Equipment Corporation PDP11 as the base system. Clearly, the main advantage to this approach is that a lot of institutions already have PDP11's. They already have the academic component running, and they have either been struggling along trying to get administrative applications implemented or they haven't done anything for the administration. With QDMS they can quickly implement administrative systems so that they don't have to spend the $50,000 to $100,000 a year over 5 years to develop an MIS system. This system is upgradeable within the PDP11.

The cost for the model hardware system is approximately $100,000. As most of you already know, you can purchase a PDP11/34 for $40,000 but, obviously if you are using the system for administrative as well as academic computing, additional peripherals and memory will be required and the system cost will will be in the $100,000 range.

The QDMS (Query Data Management System) uses the RSTS/E operating system, and the software is written in BASIC and BASIC PLUS. The cost of the system is $30,000. The QDMS software has fewer application sub-system components than the preceding systems and relies mainly on a flexible query and data management facility which is used as a basis for developing application systems.

POISE - THE POISE COMPANY

This company is a spin off of the EDUCOMP corporation and the system is quite similar to the QDMS system. One main difference is the cost for maintenance which is $1,000/month for the first year of use for the POISE system. The cost of maintenance decreases after the first year. As I indicated earlier, this cost is not entirely a disadvantage since the implication is that you will get support, and there is a possibility that the system might be tailored to the institution.

SOARS - CHAMA CORPORATION

This system uses a BTI 4000 computer as the hardware component. This system in turn utilizes an HP2000 and is marketed by a third party. It is primarily a time-sharing system and the CHAMA Corporation has developed a student information and billing and receivable system. It does not presently have a financial system associated with it although some users have indicated that this is forthcoming.

This is a relatively low cost system with the model hardware in the $65,000 range and the software costs are $14,000. Offsetting the lower costs are the fact that this is not a complete MIS system although it does support academic as well as administrative computing.

The software is written in BASIC and it is usable within the BTI hardware series with a current version being readied for the BTI8000.

EVALUATION QUESTIONS

COSTS - What's included?

Does the price inlcude maintenance for the hardware, the software, installation and support? Or, is the hardware and the system dropped off on the loading dock with a representative coming by in three months to see if you were successful in getting the system operational?

DOCUMENTATION - Is it available? How extensive?

Were you sent a computer generated list and told that this was your documentation? You can determine very rapidly how effective a system will be by how well it is documented. Now that may sound stupid, but I would be leery of not having my own staff and having to rely on somebody else when the documentation is not available. I would like to have something besides the programs. In addition to the initial documentation, the intent of the vendor to update the documentation to keep abreast of system updates is also important.

HARDWARE - Cost of maintenance? By whom?

If you purchase or lease computer X, is it maintained by the vendor or is it a third party maintenance agreement? Such agreements work well in some situations and not so well in others. It usually depends on the location, and the ability of the third party or the original vendor to service you in your geographical area.

HARDWARE - Can the system be distributed?

Is one central computer required to run the software or can several small computers be installed to run various application systems?

HARDWARE - Is the system upgradeable?

Can you upgrade within the vendor? If you are using a PDP11 can you run the system on a DEC10 or a DEC20. If Digital, announces a DEC2020 which might be less costly than a PDP11/70 and yet more powerful: can you use the software on the 2020? The answer is no in the two approaches using the PDP11 because the software is operating system specific and the architecture of the two systems are different.

Can you change to another vendor? Now that is not strictly a question of hardware; it is also a question of software. If the system is written in language X and it is not supported on the other vendor, it is not going to be easily transferable without major reprogramming costs. Even when language compatability exists there will undoubtedly be conversion costs to switch from one vendor to another.

INSTALLATION - What is the cost of installation?

Is it included in the price? Is the price $30,000 plus $250.00 a day/person until the system is operational in your environment, or is it $80,000 and they guarantee its operation? Or is it guaranteed with 30 person days of support? That's an important consideration, so don't look at the price quotation at the top of the list or at the bottom of the proposal because there may be several items including education that are excluded from the price quotation.

INSTALLATION - What is the ease of installation?

Are there referral accounts who can comment on installation ease? How long will the installation require in person/months and elapsed months? A longer phased implementation of a system with multiple application components should not be viewed as a negative feature; it might well be desirable. Installing the accounting system the first month and perhaps a registration system the next month and integrating them at the end may be advisable in a small college where you cannot get everybody working on the conversion at the same time. From this author's perspective, it is realistic to expect a lengthy year long implementation. It is important to remember that in that year, you may well be closer to an MIS than you have been with many of the other approaches or attempts to develop or implement such a system.

SOFTWARE - What applications are supported?

It is advisable to look at this item very carefully. There are differences. Just because the information is on the screen that doesn't necessarily mean that it is comprehensive or that the application will serve your needs.

SOFTWARE - Is the software integrated?

Do the application sub-systems relate to each other or do you have disjointed modules that don't converse with each other?

SOFTWARE - Does the system interface with other software?

How readily can this software be incorporated with software that you may already be using? Can the system be used with other software packages such as data base management or query systems?

SOFTWARE - Is the system modular?

Do you have to purchase the whole system or can you purchase one module (i.e. admissions) and install a small computer to perform that function?

SOFTWARE - Is the system portable?

As mentioned above under hardware, what is the independence of the system from the operating system and is the language that the software is written in vendor independent?

SOFTWARE - Is the source language available? Modifiable?

Does the vendor deliver object or source decks and can you maintain them? If you do maintain the source, do they disavow any control or support after you have maintained them? It is a little impractical for a vendor to have 400 versions of software in existence. Consequently, just because you are allowed to maintain the software doesn't necessarily mean that the vendor is going to support it forever. Another important question in this regard is the possibility of remote software maintenance. Can the vendor dial your site and make a patch to get your system running? Since none of these companies are IBM and they are all fairly small with limited support personnel, the question of how your system is maintained is crucial.

SOFTWARE - Are there yearly maintenance costs? Are updates included?

What are the yearly maintenance costs and what do they include? Are these funds really earmarked for updates to benefit current users or is it a design to provide funds to enhance the firms marketing activities? Guarantees are required which specify how these funds will be used. This brings to mind the role of the users group in bringing pressure on the vendor to make desired updates (if in fact a users group exists).

TERMINAL - Will the system support single or multi-thread?

If the controllers office wishes access at the same time as admissions, are they locked out or can they run simultaneously?

TERMINALS - Is there a query language facility?
How user oriented is this facility?
Does it come with the package?
Who developed it?
Is there an add-on cost for it?
If you don't want it, can the cost be deducted?
Is there a substitute product available from the hardware supplier?

TERMINALS - How many levels of security are there?

This is an overriding concern especially in joint academic and administrative centers. The question is whether there is security at the file, screen, application and/or the data element level.

TERMINALS - What types of terminals are supported?

Are you locked into a specific vendor or can terminals from a a variety of suppliers be used with the system?

SUMMARY

Having reviewed some of the hardware, software and cost characteristics of some of the available third party MIS systems, and having posed a series of evaluation questions, I trust that you will find this analysis helpful in making a decision to acquire one of these systems or deciding to develop your own software.

There is one question that I did not pose previously with which I would like to close this paper. That question is the ability or inability of the vendor to install, support, and maintain the system. Does the firm have stability? Can they deliver on the promises made in the sales situation should you decide to purchase? In many respects, these are the overriding issues since the best system from a specification standpoint may be impractical because the vendor may not be able to support it in your area.

	INFO CSC	INTER-ACT TAI	MSL/CAM-PUS	POISE	QDMS EDU-COMP	SCARS CHAMA
HARDWARE						
VENDOR	DATA-POINT	HARRIS	MICRO DATA	DEC	DEC	STI
MODEL SYSTEM	5500	S115	REALITY	PDP11	PDP11	4000
COST K$	60	140	140	100	100	65
UPGRADE	YES	YES	NO	11	11	NO
SOFTWARE						
OP. SYS.	DOS	VULCAN	REALITY	RSTSE	RSTSE	HP
LANGUA.	DATA BUS	COBOL	ENGLISH	BASIC	BASIC	BASIC
COST						
MODEL K$	50	80	60	25[1]	30	14[2]
APPLICATION						
ACADEMIC	NO	YES	NO	YES	YES	YES
ADMINIS.	YES	YES	YES	YES	YES	YES

[1] YEARLY MAINTENANCE 1ST YEAR $1000/MONTH

[2] INCLUDES STUDENT SYSTEM & ACCOUNTS RECEIV.

Mr. Jan Arnet
Vice President for Finance and Treasurer
Union College, New Jersey

Why INTERACT?

Abstract:

I will briefly mention the history of Union College, the management needs in the data processing area, the objectives of the control mechanisms, the search for solution both in-house and among outside vendors of software and hardware, the evaluation of the bidders, the signing of contracts with IAI and Harris, current status of the implementation, and future plans of both the implementation and usage.

I. About Union

Union College is a two-year, independently governed, coeducational college, serving as the community college of Union County, New Jersey, in conjunction with Union County Technical Institute, Scotch Plains, New Jersey, under contract with the Union County Coordinating Agency for Higher Education, and as a part of New Jersey's public community college system. It has an enrollment of approximately 2,000 full-time and 3,000 part-time students. It also serves an additional 10 to 15,000 persons in continuing education programs and community services. The College is accredited by the Middle States Association of Colleges and Secondary Schools.

The main campus is located in suburban Cranford, New Jersey and Urban Educational Centers are operated in Elizabeth and Plainfield, New Jersey.

With the approval of the State Board of Higher Education, Union College also confers degrees upon 2000 students of Union County Technical Institute and upon graduates of the Schools of Nursing of Elizabeth General Hospital, Elizabeth, New Jersey, and Muhlenberg Hospital, Plainfield, New Jersey.

The College was founded in 1933 as Union Junior College. In 1969, Union College entered into an agreement with the Union County Coordinating Agency for Higher Education to provide college-level programs for Union County in lieu of a county college. Through this contract state and county funds are made available so that tuition for Union County and other New Jersey residents can be kept as low as possible.

II. Data Processing History

In November of 1974, the Union County Coordinating Agency for Higher Education requested an evaluation of the County Community College System in the area of data automation. A committee was formed early in 1975.

The Committee proceeded to prepare a Computer Effectiveness Appraisal Manual by excerpting portions of manuals used in previous evaluations and adding questions unique to computers and education. The purpose of the manual was to be sure that the same questions were asked at each site and eliminate the difficulties of having "apples and eggs" to compare rather than "apples and apples".

Finally, recommendations were presented to the Coordinating Agency for implementation.

The following questions were considered:

1. Is the existing hardware adequate? If not, what changes are recommended?
2. Are personnel as presently staffed qualified for the tasks to be expected of them?
3. What needs are being met? Which ones are not being met?
4. What are the major problems of the moment and what are the major problems in achieving maximum efficiency of the computer system?
5. What, if any, are the obstacles in the way of having one computer system, coordinated, integrated, non-duplicative, for our System?

In examining the managerial and computer organization capabilities, the following observations were made:

1. The system has staff to meet its existing work load with a reasonable approach to solving the problem that exists in our environment.
2. The accomplishments, i.e., applications automated to date, appear to be farther along at the Union County Technical Institute. However, the staff structure, for day to day operational problems, appears to be unstable.
3. Union College, on the other hand, has automated its processes at a relatively slower pace and appears to have done them rather completely, considering the equipment, the nature of the jobs and the organizational structure, the staff stability appears satisfactory.
4. Both organizations have evolved their needs when crisis dictated it. Neither one has a good plan for future integrated automation.
5. There appears to be no comprehensive plan stating what is expected of the computer facility academically in relation to curriculum or administratively at either organization.

There did not appear to be any single budget for the data processing activity.

III. IBM 1130

Union College had at that time an IBM 1130 installation which has been on rental for eight years.

If the institution were to proceed with its planned conversion to an IBM 360/25, hardware costs would drop depending on whether a rented or purchased equipment is used. However, the institution had no formalized system for data processing planning and estimating. This was attributed to the relatively static environment which has prevailed over several years. The institution could not be considered a "large shop" and the operations of the installation were highly dependent upon the knowledge of a few key individuals. Additionally, a joint facility for the entire system was considered since the Technical Institute had an IBM 370/135 which could serve the needs for both institutions. Student usage at Union College could be handled by an RJE terminal connected to a state educational computing network.

It was evident that IBM designed and produced the 1130 system with a narrow segment of users in mind. Additionally, IBM did not provide a compatible, logical growth path to larger systems for those institutions whose needs exceeded the capability of the 1130. Union College had production requirements well beyond the capacity of the 1130 system. It was obvious that an opportunity existed for Union College to modernize its computer capability.

IV. IBM 360/25

The Union County Technical Institute made subsequently available to the College an IBM 360/25 with a 32K Central Processing Unit.

This configuration represented a significant increase in through-put speed, language availability, and accessible storage. Eventually, the College accepted this equipment and sold the 1130.

The computer needs were again reviewed in September 1975. Educational usage was expanded at that time with inclusion of mathematics, accounting and business management courses with computer support.

Conversion from the 1130 to the 360/25 of all existing applications was completed in 1976. Both academic and administrative usage of the new system were greatly enhanced. We experienced a 25 percent reduction in computer operating expenses. With the stabilization of the new computer system, new applications were quickly forthcoming. The equipment was expected to be capable of meeting the computer resource needs of the college for the near future. The software expenses were spread over a two year period postponing the major commitments in software funds at least one year. There was still a need for a program capable of generating reports and variety of utility functions, allowing for the delivery of reports that were unplanned in a minimum of time with a minimum of effort. However, in order to develop an effective level of computerized accounting support in the shortest possible time, we needed an additional programming staff.

We knew that it is not always true that when an institution converts from manual to computer processing clerical positions are displaced, however, in our situation it appeared highly probable that fewer clerical positions would be required to process the same amount of work. We also recognized that effective computerization requires the utmost in careful planning.

1. User specifications must be defined in general terms at least six months prior to system implementation.
2. Final specifications must be made at least four months prior to implementation at which time specifications will be frozen at least through final testing.
3. Requests for one time reports must be evaluated on an individual basis to ascertain whether the data may be obtained elsewhere. In general, requests of this type should be discouraged as they will delay the overall schedule of new application developments.

An updated version of the Union College Computer Services Users Manual was needed but never completed for lack of time and personnel. We needed almost instantaneously but found it impossible to get:

- Documentation of Existing Systems
- User Education and Training
- Course Adjustment/withdrawal reporting
- Master Schedule Production Assistance
- Institutional Research Assistance
- Modification to Registration and Accounts Receivable Systems
- Computerized Reporting of Non-Credit Program Registration
- Institutional FTE reporting

- Faculty Load Analysis
- Budgetary and Financial Statement Reporting
- HEGIS Reporting
- Facilities Inventory (Space Utilization)
- Students Accounts Receivable Support
- Student History and Transcript System with Degree Crediting
- Instructor Grade Analysis Reporting
- Automated Alumni File Updating
- Financial Aid Reporting System
- Integration of Student Admissions/Registration/Accounting sub systems
- Payroll/Personnel System
- Purchasing System with tie-in to Budget System
- Facilities Scheduling (e.g. Master Schedule room assignment)
- Inventory Control System
- Multiple choice test scoring and detailed test analysis
- Library Circulation System
- Computerized Individualized Learning Packages for Students
- Computerized diagnostic test scoring with cognitive mapping capability
- Implementation of Computer-Managed Instruction

The framework for a versatile and flexible reporting system had been laid by the Office of Computer Services in consultation with Business Office personnel. However, an impass had been reached which seemed to be related to a realignment of a number of college departments in the general ledger. as well as a possible revision to the monthly financial statement.

V. Alternatives

It became quite obvious that another reconfiguring and upgrading of our computer system was needed, specifically, on-line processing capability. Strong support for this technology change had been voiced from the Business Office, Admissions, Financial Aid, Counseling and Registrar's Offices. The system would have to accomplish the following:

1. Provide continuity of support for academic and administrative computer needs at least at current levels
2. Stabilize our computer configuration for future planning
3. Provide growth capacity within the new configuration anticipating the future needs of the college
4. Provide on-line processing capability to satisfy current and future application requirements
5. Reduce current costs and/or cost avoidance in future manpower and equipment needs
6. Increase productivity and managerial control in such areas as registration, accounts receivable, budgeting and institutional research.

We have constructed six alternative paths, ranging from merely replacing the 360/25 through installation of a 370/115 computer system. We have also prepared a staffing plan, application development schedule and cost overview. It is important to stress that the cost estimates represented a broad overview and would have required much refinement if and when a basic strateg had been selected. It would be well to point out that the major reason for the wide spread interest in on-line processing stemmed from a basic need in every office for more information, available in a time frame and place appropriate to deal with our changing enrollment patterns.

Rolling and continuous registration are no longer the exception. Our mission of community service has taken us to a variety of locations throughout the county to admit, register and instruct.

In contrast to batch processing, on-line interactive processing makes information instantly available to different users for varied purposes. Since on-line updating takes place, the computer files always reflect accurate and up-to-the-minute information. With this technology "walk-in" registrants may be admitted, registered, invoiced and cleared through the business office in a short period of time. Course adjustments can never result in overloads since drop/adds are updated as they occur.

Statistics show that a greater degree of accuracy is achieved because those who are most familiar with the data are actually responsible for data entry. However, the most significant benefit to be achieved is in greater control and efficiency for administrative decision making. Course loads, faculty loads, and budgets may be monitored in the time frame necessary to make effective decisions resulting in lower costs.

A number of alternatives were considered. They provide a number of solutions, but do not all achieve each of the stated objectives, some achieve the objectives but at unreasonable costs:

ALTERNATIVE I. Lease or purchase additional storage for the 360/25. This plan would result in an immediate increase in cost with no increase in capability. New batch systems may be developed. However, this system would be saturated in 1-1/2 years.

ALTERNATIVE II. Lease or purchase a 360/30F to replace the 25. This plan provided for future growth capacity. Adequate on line support would not be effectively achieved, however, new batch systems might be developed. With a modest upgrade in disk capacity in 1 to 2 years, this system would have met most future batch processing requirements.

ALTERNATIVE III. Lease or purchase a 360/30G which would provide teleprocessing capability while supporting current batch applications. An immediate increase in cost was apparent due to additional hardware and teleprocessing software. Savings could be made in the elimination of clerical positions engaged in processing paperwork to support batch oriented systems. Additionally, we could avoid future cost of personnel in the office of computer services as new applications would be computerized for on-line delivery.

Other savings would be observable in the form of greater efficiency, more timely reporting and a reduction in the paperwork necessary to be compiled and processed by professional and clerical personnel.

Computer application software to provide on-line admissions, registration, and business functions may be obtained from a variety of sources at little or no cost. Since many New Jersey and other Community Colleges were currently using on-line technology, the acquisition of adequate software would not have been a major problem area. The extent to which modification of that software is required would determine the time frame for installation, testing and implementation of on-line technology for Union College.

ALTERNATIVE IV: Lease a remote job entry card reader and line printer, telephone modems, high speed teleprocessing line and process all current batch applications via telephone lines using the IBM 370/135 installed at UCTI. This alternative in addition to a substantial increase in our own operating costs would have required UCTI to purchase and lease additional core and disk drives to support our applications.

On line processing would have been possible but at substantially increased costs. Priorities, control and scheduling of computer resources would have been very difficult.

ALTERNATIVE V: Lease or purchase one of several mini-computer systems specifically marketed for educational administrative problem solving. There are a number of advantages to this option, namely: Application software is available and supported by the vendor for such areas as admissions, registration, business functions, financial aid, and alumni development. The overall cost of the system is relatively low.

Among the disadvantages to this plan were: The highly competitive nature of the industry which frequently forces vendors out of the market, and often leaves users without support; a lack of broad academic support applications which would require that we provide remote job entry capability for our students at additional costs (Fortran, Cobol, RPG and PL/I were not usually provided on most mini systems). A multitude of application packages for academic support are available for use on standard size mainframes. These packages would have been accessible only through another computer source. As priorities and applications change frequently, upward growth is more difficult within the mini computer spectrum due to the idiosyncrasies of each mini system.

ALTERNATIVE VI: Lease a 370/115 which would provide on line and batch capability at high speeds. While this plan provides all the benefits of Alternative III plus having the advantage of state of the art hardware, the fiscal constraints within the county would probably prohibit the acquisition of a 370 computer by Union College.

We have prepared a cost comparison between the most feasible alternatives II and IV above.

Since the Coordinating Agency has approved in principle a plan calling for the consolidation of computer resources of the College and UCTI, alternative IV represented one of many ways to achieve that objective. It was, however, costly and less responsive to the needs of Union College and would require further upgrades to achieve on line processing capability. Consolidation would only become economically feasible through careful planning, reduction in staff, and a commonality of application programming.

Installation of a remote job entry station at Union College, and additional equipment at U.C.T.I. would have resulted in none of the above advantages. Indeed, one could predict a degradation of service at an increase in cost. While the internal speed of the U.C.T.I. equipment is faster, effective turnaround would be reduced for both academic and administrative usage. In addition, Union College staff members often worked on Saturdays to test new programs at no expense to the College.

Since our computer facility was available 24 hours, 7 days a week to all staff members, reducing the availability of the resource to 16 hours at 5 days would have a negative effect on new applications development.

There would have been no reduction in staff at either institution and indeed at peak times U.C.T.I. might have required additional personnel to accommodate our needs.

A review of the work load at both institutions indicated that we had similar peak periods.

In general, technologically, the alternative was possible and would have achieved to some extent a consolidation, but the additional cost and degradation in service did not constitute a reasonable alternative to replacing the 360/25.

We have, therefore, decided to retain the use of the IBM 360/25 for the 1976-77 academic year. This was the least expensive way for the College to meet its needs at least through June 30, 1977.

However, we were well aware that the 360/25 capacity was not expandable and per our projected need of computer applications, the system would have been saturated by June, 1978.

At that time we were still considering leasing a 360/30, since the lease could be terminated whenever an adequate consolidated computer resource is operational. It should be pointed out, too, that this proposal, according to our calculations would have been at least three times less expensive than if the College were to make use of UCTI's 370/135.

VI. Academic Needs

At about the same time, the academic administration voiced their own concern. It was suggested that future committees addressing computer utilization include a broader representation of the departments in order to facilitate greater input college-wide. It was also suggested that future investigations include broader areas of possible computer use. The program areas were appropriate but not inclusive in the possible uses in a community college. Some areas were found to be non-existent at Union College.

The Business Department was considering an additional offering to expand the one-semester course to a one-year sequence. No action has been taken thus far.

The MAT 108, Basic Programming and Applications course has been developed and is currently being offered. It was the intention of the Math Department to extend the Statistics course to a two-semester sequence to include extensive computer usage.

There were inquiries about the status of the computer with regard to utilization in the Engineering lab courses in the area of graphical display, the revision of the Engineering Graphics sequence; however, no steps were taken to develop proposals in this area.

Other educational and related needs were conceived: a)Faculty involvement in the use of the computer facilities in connection with either their graduate or professional work.b)Institutional Research reports on student and other data useful to the academic departments, c) Benefits that may be derived from a computerized system of control and retrieval in the Library, Reading Center, Math Center, and the various labs of Chemistry, Physics and Biology.

It was pointed out that the computer equipment utilized for academic use should be separated from the equipment allocated to administrative uses. Until the possibility exists for an open lab situation for academic use there would of necessity, be limited academic utilization, since administrative use had essentially been given priority.

One major area that was not addressed was the possibility for computer-assisted instruction. This is one of the important areas especially since grant monies are available through NSF and other federal agencies.

The result of all this was the establishment of a college-wide computer advisory committee which annually assesses the computer needs of the academic segment and makes recommendations to the Vice President for Academic Affairs.

VII. Organization

In order to better understand the human side of our computer development, one should briefly describe the management organization of the College.

Prior to the inauguration of the current President in the Summer of 1974, the academic arm of the institution was headed by a Dean of the College, while business functions were under a Vice President and Treasurer. Dr. Saul Orkin reorganized his cabinet to include a Vice President for Academic Affairs, in charge of all academic programs, including continuing education, community services, special programs and the Library, a Vice President for Finance to be responsible for budgeting, accounting, treasury, non-academic personnel, purchasing, auxiliary services and plant operations, a Vice President for Administrative Services and Public Affairs to head Admissions, Registration, Institutional Research, Public Information, Publications, Alumni Affairs as well as Computer Services and Dean of Student Affairs in charge of Counseling, Student Financial Aid, Placement/Testing, Campus Center, Athletic Programs and other student service functions.

In 1976, shortly after the retirement of the former Registrar, the Computer Center Director, who had been instrumental in most systems upgrading and improvement projects in the past, was elevated to a position of Dean of Administrative Data Services, again under the Vice President for Administrative Services and Public Affairs. The new Dean was made responsible for all student-related administrative functions from admissions to registration and the computer services, his previous job.

Not being threatened by a vision of a dead-end job and a potential reduction of his work force, the new Dean became the leading proponent of the mini-computer concept.

It is vital to recognize that the human elements of any progress play a much more important role than any fiscal, political or operational considerations. Union College was not an exception to this rule.

VIII. Mini On the Horizon

In January, 1977 it seemed that decision had to be made concerning the future of computer services at Union College.

The President expressed a desire for more information on possible computer alternatives. After deliberate consideration and in light of the imperatives concerning student record keeping, we have prepared three new alternatives for his consideration.

Even if there were no external forces for change, internal needs finally required a computer upgrading shortly. The changing nature of our student population and the mounting paperwork associated with the admissions, registration and bursar functions resulted in frequent log jams.

The data has been collected, coded, punched, verified, edited, loaded, listed and included in a variety of reports. This process intensified, of course, as we proceeded through the registration process, however, as new computer applications were implemented, bottlenecks occurred more often throughout the year.

In a time of rising costs and decreased funding, the need for timely management reporting covering enrollments, faculty load, budgets and labor relations became more critical.

To meet these needs we have decided that it was essential to move away from the traditional batch oriented data processing in favor of on-line processing. We knew that other community colleges have already implemented this type of processing with a high degree of success.

We concluded again that any change in hardware must meet these general objectives:

1. Provide continuity of support for academic and administrative computer needs at least at current levels
2. Stabilize our computer configuration for future planning
3. Provide growth capacity within the new configuration anticipating the future needs of the college
4. Provide on line processing capability to satisfy current and future application requirements
5. Reduce current costs and/or cost avoidance in future manpower and equipment needs
6. Increase productivity and managerial control in such areas as admission, registration, accounts receivable, budgeting, and institutional research.

Again, essentially, the following options were considered:

I. Upgrade the current computer to a larger and faster model of the IBM 360 line of computers. Specifically a system 360 model 30 with sufficient storage and peripheral equipment to achieve our objectives. However, the disadvantage was a 18-24 month lead time to meet short-term operational objectives. Also, future upgrading would have been more costly since this type of equipment is already obsolete.

II. Consolidate computer operations with UCTI forming one computer facility with a satelite station located at UC used to feed punched cards over telephone lines to the central computer location presumably at UCTI. Technologically, this was possible, however, our participation in controlling and scheduling our own processing requirements might be placed in the hands of others. In addition, this would have been the most costly option since required new equipment to be installed at UCTI immediately, it would take 24-36 months to meet short term UC operational objectives, and staff must be highly trained - hence costly.

III. Purchase a "Mini" computer specifically marketed to educational institutions which includes 80 percent of the necessary application programming completed by the vendor at the time of installation. In addition a high speed data link in telephone lines would be established between UC and UCTI to use the Institute's computer for programs not available on the Mini, for example the Program Cost System required by the State. This option is attractive but contains a degree of risk in terms of vendor support. However, most of the short and long term applications which the College would hope to implement during the next three years could be operational within 18 months. This option represented a desirable compromise. UCTI would maintain their current equipment for all academic work as well as its own administrative applications and revenue-generating outside users' services.

It was noted that this option might have been questioned by members of our Board since it deviated from the major computer vendors for equipment and support. We knew that if we had selected this option we must have done so with full top management support.

The obvious advantages were:

- A wide range of applications available on line,
- Short term operational objectives could be met in one year
- Less sophisticated and smaller staff would be required
- It is the least expensive option
- It provides students with hand-on equipment

Simultaneously, we prepared a document to serve as a reference for the Union County Coordinating Agency standing Computer Committee in determining administrative system-wide computer needs.

In this document the major college systems were again identified and the interaction between systems shown.

A needs statement was prepared including a new assessment of the current applications which were either converted from the older computer or designed for the existing IBM 360/25 computer. It was clear that the existing systems in no way represented satisfactory computer support to the college. Applications were designed within severe memory and disk storage constraints.

The needs of the college in terms of identifying current and proposed administrative applications were clear. It was also clear that many new avenues of educational endeavors are being opened and will require proper registration and accounting records. To attempt to maintain the existing application programs as well as adding new functions in a batch processing computer environment would have resulted in the need to hire additional clerical staff just to prepare, edit, punch and process the ever increasing amount of paper work. The diversity in non-credit program offerings had increased the head-count so acutely that the existing systems bottleneck.

We knew that most of all we needed an on-line student administrative and accounting system.

The essential elements in the short term,as required by the college, were to provide on-line interactive admissions, registration, course adjustments, and bursar functions. These applications are in no way luxury or wish list items. A basic tenent of the community college mission is to be as flexible and accommodating to the needs of the community as possible. We knew that unless this type of computer support is provided,either of two alternatives exist: One being a reduction of services - which was unacceptable or two, an increase in clerical and professional staff was needed to organize and control basic student and accounting records.

It seemed clear that the time had come to modernize our computer support in favor of a technique that will ultimately reduce costs and provide substantially more efficiency within the community college system.

IX. Existing Applications

In the meantime, our capable computer staff developed all basic operational applications which were and still are batch-processed on the 360/25:

1. Admissions

The Admissions office initiates all data concerning applicants. This is accomplished by preparing a general information form. These forms are collected daily and information in punched to create or update a student record on disk. Weekly, a statistical report of applications and registrations as well as an alphabetic listing of all applicants and current students is sent to the Director of Admissions. Once a student has been accepted by the College, registration materials are prepared for the student and forwarded to the Registrar's Office.

2. Scheduling

When the master schedule is completed, the Computer Center keypunches the courses and a disk file is created. The Registrar's Office is responsible for maintaining the integrity of their file.

During the registration process, pre-punched cards are sent to the computer center to schedule the students. Each card adjusts the number of left and taken seats for a selected course. In turn, the courses are added to each individual student's record on the student file.

Daily, a listing of the student schedules is printed in alphabetical order for use by the counseling staff and the registrar and bursar.

Periodic listing of the course master file is provided to allow for changes and additions.

3. Registration

Prior to each semester, a registration form and other registration materials are mailed to each current student. These students, who wish to register by mail, return the completed registration form along with fees and tuition. The course selections are sent to the Computer Center and the students are scheduled and file counts are adjusted.

At the end of the alloted period for mail registration, all students who have not paid their fees or tuition are sent a permit to register in person.

During registration, students select courses and pay their fees and tuition. All students who do not pay, lose the selected seats in the courses, this maintains an accurate count of registered (paid) students who will be attending.

Reports on the number of seats taken in each class are provided by the Computer Center twice each day during the registration process. These reports reflect accurately all transactions during a given period and all the deans and department heads to cancel or add new sections as needed.

4. Exam Scheduling

During each semester, the Computer Center sends a list of all the courses to the Registrar's Office. Each course to give an exam is selected and returned to the Computer Center. These selections are then scheduled by days and number of sessions for exams to produce the least number of conflicts for the students. The Registrar's Office is then provided with the exam schedule for typing and distribution.

5. Grade Reporting and Transcripts

Mid-way through the fall and spring semesters, class lists are provided for each instructor to report on all students who are doing unsatisfactory work. The Computer Center provides a list of these students so they may be notified.

The final grading system provides the instructors with a listing of all students. The instructor fills in the grades and returns the lists to the Registrar's Office. The lists are then forwarded to the Computer Center for keypunching. The grades are then loaded to the students records in the computer and a grade report of all their courses and averages is printed and mailed to each student. At the same time as the grade reports are printed, lists of the students are provided with grading information for the Academic Evaluation Committee. The students are then evaluated for dismissal or probation as necessary. The Computer Center provides lists of all possible evaluations on students based upon their grades.

After all changes have been made to the grades, the transcripts are printed for new students and a permanent label is produced for all current students which is afixed to their transcript each semester.

6. Accounting System

The Business Office controls all data concerning the accounting system and is responsible for maintaining all accounting master files.

The Accounting System provides the Business Office with reports on Accounts Receivable, Accounts Payable, Cash Receipts and Disbursements, Journal Entries, Master Vendor File update, complete monthly updatings of the General Ledger in account number order, a Chart of Accounts run, an Object Code Report,Departmental, Divisional and College-wide Budgetary Status and Encumbrance Reports, Monthly Balance Sheet, the NCHEM's-based Induced Course Load Matrix, Faculty Data Generator, Cost Finding Principles and RRPM 1.6 (Program Cost Study) reports as well as Transaction Edit listings for all data processed through the system.

7. Alumni System

The Alumni Relations Office is responsible for updating and maintaining the alumni history system. This system provides a complete historical record of former Union College Alumni, as to name and address, session, and curriculum taken. The system is updated semesterly, producing complete master listings, edit listings of inputed data as well as mailing lists and labels.

8. Counseling

The Coordinator of the Academic Placement Testing Program receives mailing labels and lists of full-time students who have paid their general fee. This date is provided weekly in conjunction with an alphabetic listing of all new students.

A report on placement testing is generated from the testing information sent to computer services by the coordinator of the program. Periodically labels and lists are also provided as a service to this department.

9. Other Applications

Other applications include institutional research statistics, student financial aid, summaries of FTE student reporting required by the State of New Jersey, etc.

Average production statistics by semester is as follows:

Computer Services User	% of Usage
Academic Usage	20
Registration Office	15
Business Office	15
Admissions Office	5
Office of Institutional Research	3
Public Relations Office	2
Office of Continuing Education	2
Counseling Office	1
Divisional Deans	1
Financial Aid Office	1
Health Services	1
Library	1
Schools of Nursing	1
Security Office	1
Subtotal	69
Testing	9
Non-Production	18
Down Time	1
Preventative Maintenance	3
Total	100

X. IBM 370/138?

Independently, the Union County Coordinating Agency for Higher Education requested IBM to prepare alternative proposals for efficient and cost effective computer operations in the Community College system.

Specifically, it was requested that IBM evaluate the computer needs of both institutions in the system and those of the Agency itself, and prepare a detailed plan which should have included the following:

- Ranked alternative solutions
- Specific computer equipment configurations
- Auxiliary equipment needs
- Software requirements
- Cost analysis of the alternatives presented
- Recommendations concerning staffing in terms of numbers and types of positions required

Specific evaluation of the following alternatives was requested:

A. Upgrading of the existing UCTI equipment to serve the needs of the system as a single central site

B. Acquisition of a different computer system also to serve as a central site

C. Implementation of a two-computer system, one for general academic usage, and one for administrative purposes.

D. Utilization of the state computer network for academic and for administrative needs.

In reviewing these alternatives the Agency considered the first priority to be academic usage, second administrative needs and thirdly the service bureau function to outside clients currently performed at UCTI.

Since the Agency had resolved at that time that the institutions should operate a single admissions, registration and record keeping system, it wanted to plan for the integration of these functions on available computer equipment.

In response to the Agency's request, IBM has put some material together to enable an evaluation of the consolidation of computer facilities at Union College and Union County Technical Institute based strictly on hardware and software costs.

Combining the costs for each institution,it appeared that the total additional cost would have been $550,000 assuming that hardware and software additions are extremely minimal.

At the same time, IBM recommended that the 370/135 at UCTI be sold and replaced with a 370/138 and that new gear be installed at Union College. This included an IBM 3776 RJE Terminal and a cluster of four IBM 3277 CRT's. However. the cost of modems and lines was not included.

The total cost over a five-year period assuming only hardware/software costs, purchase of the 138 and its resale in 1982 would have been $730,000.

It became clear that this would have been impossible to implement due to the amount needed. In addition, considerable additional staffing would be required to develop the on-line interactive capability.

At that time, we also contacted most of the software companies providing support for the alternative mainframe hardware configurations: MSA (Management Science America, Inc.), SCT (Systems and Computer Technology Corporation), EES (Education and Economic Systems, Inc.), EDIT (Educational Data and Information Techniques) as well as other higher education institutions which have developed for either their own use or for outside marketing various software applications.

We corresponded with IAI (Information Associates, Inc.) as well. However, neither IAI nor the College were ready for a solution to which I will get to shortly.

XI. Crisis

In December, 1977 we frequently spoke about the impending crisis in providing continuous computer services at Union College. We reached the point at which we could no longer increase services and we feared that unless we took direct steps to alleviate the situation, we would have been forced to place a moratorium on all new application developments.

Essentially, we were faced with:

1. Aging equipment, which required increasingly more maintenance and preventive maintenance
2. A 50 percent increase in student enrollment in computer-related courses which was expected to increase
3. More requests for the implementation of a comprehensive administrative and financial reporting system integrating all data files.
4. Need to implement a joint Union College-U.C.T.I. Admissions and Records system on our aging computer equipment

To elaborate further, the equipment we were using was not designed for the quantity of work we were trying to make it perform. Architecturally, it was out of date with respect to the needs of the institution.

Additional shifts have been added over the past several years: At first, an additional 1/2 shift, then a full second shift and as of that fiscal year, a third shift for long production jobs. Saturday morning had been added to the schedule, exclusively for academic work. The volume of work has increased disproportionately to the ability of the equipment to process it.

We knew that if we continued to do nothing, we would be faced with a degradation in computer services which would seriously impair the academic and administrative missions of the College.

New programs and/or subsystems must have been created to satisfy these needs. However, in my opinion, it was unsound to continue to develop new software for the IBM 360/25. It was clear that a solution to the computer issue must be found in the very near future if we were to continue to meet our institutional responsibilities. A decision made within the next two months would enable us to schedule a conversion effort during the summer months. If, however, a solution cannot be found shortly. I was afraid that with the press of daily operation responsibilities we would lose yet another year.

In seeking a solution, therefore, we again examined what alternatives existed and to what extent each one would meet our needs. In doing so we had to consider the recommendations of the Agency's Computer Committee, as well as the needs of the U.C.T.I.

Essentially we had two viable options:

A. Implementation of a single central computer serving both institutions and the Agency for all administrative and academic needs

B. Diversification of computer resources using (1) the existing U.C.T.I. computer, (2) a second "mini" computer for administrative processing only and (3)the New Jersey Educational Computer Network.

Assuming that for Option A the mainframe selected would be an IBM 370/138 as IBM has recommended to the Agency, we agreed that this system properly configured could bring us to a desirable level of administrative sophistication. However, in order to utilize such a system, a large well-trained staff would be required and we might not expect to reach our anticipated level of software development and integration for three to five years.

In contrast, option B held out a dramatic leap forward in processing technology with the capability of meeting our administrative objectives within 12 months. Employing this option, Union College would install a mini-computer at its Cranford campus while concurrently installing a remove job entry terminal for student use. UCTI would off-load its admissions, registration and academic record processing to the College, thereby freeing its existing 370/135 for a greater share of local academic work and possibly provide Union College with academic computer support. Overflow academic work from either institution could be run at the New Jersey Educational Computer Network. This option is extremely cost effective since it utilizes the most appropriate hardware/software combination to meet both academic and administrative needs.

A cost comparison (including hardware, software, staff and supplies) over five years indicated the following:
Option A - $3 million. Option B - $2.6 million. Continuation without change of the existing hardware at both institutions would cost the System $2.4 million over the same time period.

Option B became uniquely attractive because several computer vendors market complete hardware/software packages including the operational and fully-integrated systems.

By taking advantage of "state of the art" data communication techniques offered by this option, administrative data processing would become part of every college office. Each office would have direct access to the computer.

A system based on the concept of distributed processing is ideally adapted to our administrative needs. In seeking a solution to this problem, I was mindful that while our needs are many, we do not necessarily require a large general purpose computer system to solve them. Rather a smaller dedicated system providing "user" oriented problem solving abilities is more desirable.

I therefore, recommended the replacement of our existing hardware in favor of a system as referenced in Option B.

We believed that we found a solution to the entire computer issue. A mini-computer system with a developed administrative software package, by design fully integrated, would move us years ahead in processing technology.

Admissions processing would be taking place at the same time labor negotiation analysis were being performed. On-line registration would be possible whenever and wherever a registration was planned, the only requirement would be that a telephone line be available at the registration site.

Unique management reports would be available in minutes instead of weeks by using equipment and software in the true data base-data communication sense. Managers would have access to the integrated data files via television-like terminals located in their offices. And by using a highly sophisticated report requestor, the average "non-computer" type administrator could have any number of reports/lists/labels available for use in minutes. We told the President to consider the impact of negotiators knowing precisely what a fraction of a percent change in salary or fringe benefits would have on the college budget, to consider the impact of being able to go to a student gathering with a computer terminal to be used in preparing a complete financial aid analysis for a prospective student in seconds, to consider the ability to deliver computer services 24 hours a day, 7 days a week to any college office with a minimal computer staff.

My own feeling was that within nine to twelve months after installation of such a computer system, not only the Agency, but also UCTI would be interested in converting much of its administrative work to the same or similar system. I envisioned that the existing computer equipment at the College would have been sold on the used computer market with the proceeds offsetting some of the costs of the new equipment. Along with the switch to a new administrative computer system and in order to serve current and future academic batch processing needs of the College, we could concurrently install a dedicated batch terminal, exclusively for student use. This terminal would be connected to the state educational computing network at Rutgers University via telephone lines. Virtually every conceivable academic computer support service is obtainable via this plan, and I was sure it would have the support of the faculty.

To briefly review:

1. Our installed equipment could not support our current needs adequately.
2. New administrative services were badly needed.
3. Academic support was suffering.
4. Action was necessary.
5. A solution was possible with the installation of a new computer system and academic support terminals.
6. We could implement this type of solution within the current budget, and within a 12 month period, including conversion.

XII. Basic Timesharing Or MSL?

We have surveyed a number of computer vendors seeking not only the hardware necessary to solve our problems but also the software solution to our problems. Two such vendors had the ability to install a comprehensive administrative computer system. At that time, they were Minicomputer Sales and Leasing, Inc., and Basic Timesharing, Inc. Both companies were given the same information as to number of students to be served, our unique arrangement with UCTI and a specified number of terminals to be installed in a two phase implementation schedule. The software systems required to be supported by each vendor were listed.

Both vendors have worked hard with the College in determining how they may be of service to us. Basic Time Sharing, Inc., markets a modified computer mainframe CPU. A software support package called S.O.A.R.S. (Student On-Line Administration Registration System) is supplied by a San Diego-based Chama Corporation headed by Dr. John Happerton, an outstanding computer specialist. However, the system does not include a "user" oriented English language report generator, and a variety of required software packages are not as yet available. (e.g. Personnel)

Minicomputer Sales and Leasing, Inc. uses Microdata's Reality CPU and peripherals. Microdata is a recognized leader in the mini computer field with a large customer base in the New York City area and a growing list of customers for the specific hardware and software we intend to use.

This would have been a single vendor support for hardware and software since MSL is located in Union, New Jersey. Local backup, perhaps via a reciprocal arrangement with other MSL clients, Upsalla College and Drew University, would have been advantageous. MSL supplies comprehensive English language "user" oriented report writer and more extensive software.

MSL's implementation schedule, based on a February 1, 1978 contract date could have an on-line admission, registration and bursar functions cut over before the second summer session in July, 1978. What remained to be reviewed was the cost savings and/or cost/benefit to be achieved by implementing their plan. We projected that the installation and training and conversion to the MSL hardware and software systems would require a six to twelve month effort during which time both computer systems were to be maintained. At the end of this conversion cycle our current equipment was to be sold. It was anticipated that at the same time four to five staff members would be reassigned or terminated. Both of these actions should have provided additional funds to offset the cost of the new computer system. Savings on paper usage would also be significant since it was clear that the use of an on-line approach to data processing requires only a fraction of the paper required to feed a batch processing system.

XIII APPROVAL

The Coordinating Agency had imposed early in the process a moratorium on computer purchases pending resolution of the various studies performed or ordered by its Board committees.

At this juncture, we felt an alternate solution to the computer problem may be achieved by:

Increasing the memory and disk capacity of the IBM 370/135 at U.C.T.I., while simultaneously installing a mini-computer at Union College to replace the IBM 360/25. All instructional work for the Community College System will be run on the 370/135, while all administrative work related to admissions, registration, student financial aid, student billing, grade reporting and transcripts for the entire Community College System will be run on the mini-computer at Union College. By establishing a data communication link between Union College and U.C.T.I., both institutions will profit from a mutually beneficial mix of hardware and vendor-supplied software. Union College data processing functions not appropriate for the mini will be channeled to the 370 system (e.g. program cost system, faculty research, etc.).

In reaching this conclusion, we recognized also the difficulty both institutions have had in recruiting and maintaining well trained data processing personnel for the purpose of upgrading current applications and implementing a variety of new administrative services. The current salary structures at both institutions did not permit us to attract qualified personnel.

Therefore, we recommended a plan, which would achieve the following benefits:

1. Provide a higher level of academic support, including substantially more computer time to the students of both institutions.

2. Integrate computer services at both institutions and eliminate some duplication of effort in the areas of admissions, registration, financial aid and record keeping.

3. Decrease personnel costs by reducing the current number of data processing personnel at Union College.

4. Increase services to both institutions and the Agency by distributing access to the computerized data through a data base management system.

5. Provide some previously unavailable administrative services in a short period of time via vendor supplied software for both institutions, which may not be possible by using our existing staff.

6. Promote good-will with students and the public by providing accurate and timely data concerning enrollments, schedules, and community services, etc.

The price tag of the IBM mainframe solution and the continuous effort of the College administration in explaining the benefits of a distributed system, the support of the mini-solution by the College Board of Trustees and a personal involvement of the Agency's Vice Chairman, a banker by profession, responsible for a major data processing center of his own, eventually led to the lifting of the moratorium in Summer, 1978.

Others, less informed officers and staff of the public body, were provided with materials dealing with the subject and invited to visit the college sites and vendors' presentations of the "state-of-the-art" applications.

Those who didn't know and were afraid to ask, we spoke to and briefed all who wanted to listen to such things as mainframes and mini's, data bases, batch or on-line processing, distributed processing, inter-active mode, user-oriented systems, etc.

During the last two academic years, and also this year, we still have the IBM 360/25, employ 12 persons in our Computer Center, occupying some 3,000 sq. ft., at an annual cost of approximately $250,000.

There has been no data base activity and all systems are batch-oriented with traditional files, using sequential or indexed-sequential access methods.

XIV - IAI - HARRIS

Finally, in July of this year it was possible to move toward implementation of a solution to the computer problem. It was vitally necessary that we involve our users in the process. This was necessary for several reasons:

1. We found that IAI software coupled with Harris hardware eventually appeared to be able to satisfy our needs at less cost than others.

2. Their solution entailed a sharp reduction in data processing personnel; theirs is the system with the best fit and flexibility for user modifications.

3. We would be responsible for the processing of Admission, Registration and student records for both institutions of the County system.

4. The cost and capabilities of other vendors under consideration varied substantially as of this date.

5. Our user departments were not sufficiently aware of computer capabilities to be in a position to make a vendor selection and therefore must be aware of the detailed capability of the system so that erroneous expectations are kept at a minimum and satisfaction is maximized.

6. A degree of risk is always present whenever a system is changed. We have prepared a list of the areas we must review with our users over the next month.

Our approach was to organize a team to review the subject matter instead of approaching this on an individual departmental basis.

We know that even though we were anxious to move this issue, the selection process and final decision should not be rushed since its impact would be felt by the College for years to come.

We knew that IAI would make themselves available to us as necessary including evenings and weekends over the next several weeks. It was suggested that we prepare a plan of action which would result in a decision making process to acquire our new system. We envisioned the following sequence of events:

1. IAI and Harris review College's needs	7/19
2. Proposals and documentation received	7/21
3. Proposals and documentation distributed to users	7/26
4. Proposals reviewed with respect to needs	8/4
5. IAI meets with users or team to answer questions, demonstrate capability, walk through the system in detail	8/11
6. Financing arrangements analyzed	8/18
7. Decision made	8/18

The decision was made on time, the contracts were signed in September, the first software manuals arrived and briefings were held in October and the hardware was delivered in November. Now it is only up to us to implement.

I should point out that the major selling point on my part was the fact that we can implement this move into the space age fully within the existing Computer Center budget, with potential future savings when we dispose of all the existing equipment and some staff.

I won't make a sales pitch for the two companies. They will make their own presentations and demonstrations as part of Track V this afternoon and tomorrow. It is called INTERACT.

I can tell you that we lease - purchased HARRIS' System 125, which is a member of their Series 100 family of systems. It has accessibility through all modes of operations and a multi-language capacility and it is well expandable to fulfill our needs in future years.

On-line storage capacity can be expanded up to 2 million bytes. The system can support up to 32 terminal users. We are planning to achieve full utilization within three years.

We have separately lease - purchased IAI software upgraded to work in an inter-active mode on Harris' hardware. User instruction and on site training is provided as well as documentation and manuals. We will install eventually all segments of their software, including Financial Accounting, Accounts Payable, Student Records, Student Finance, Financial Aid, Personnel and Payroll.

...

A college-wide task force was established, composed of all Vice Presidents to oversee the implementation and make policy decisions, when needed.

There already are several policy matters which should be considered for resolution at some time in the near future:

1. To what extent and when should UCTI be brought into the overall system?
2. System Security considerations such as who should have access to information and at what level?
3. Allocation of terminals to various users.

A functional task force has been established and began work on the first component to be implemented - the Financial Accounting System. Members of the functional task force are:

- .Controller (as Chairman)
- .Bursar
- .Director of Budgeting and Grants Control
- .Director of Business Operations
- .Director of Auxiliary Services and Purchasing
- .Director of Financial Aid
- .Director of Accounting
- .Director of Computer Services

XV. THE FUTURE

The future of higher education is not bright. We can anticipate that in light of recent enrollment trends it will be necessary to attract a larger part-time student population to maintain our full-time equivalent funding base. Diversified enrollments in new and perhaps non-traditional or non-credit programs will require greater support for effective institutional management. Each enrollment, regardless of the number of credit or contact hours, requires virtually the same amount of computer resource. Additional enrollments and new administrative computer services (e.g. processing U.C.T.I. Admissions) have only served to splinter our computer files and degrade services at a time when more efficiency was required. I could easily predict the need for additional clerical personnel in the near future to compensate for the inability of our old computer resource to meet our needs. I could cite recent examples of requests from external agencies for data which could not be prepared in a timely manner. Simply put, our previous computer equipment could not keep pace with the expanding needs of the institution.

Predictably, with increased emphasis placed on institutional research, placement testing, facility utilization, and fiscal controls the need for data from both internal and external sources will rise sharply. Indeed, data collection and analysis in preparation for our Middle States accredidation will draw heavily on our computer files.

I am also mindful of the invisible cost of not being able to react quickly enough to changed needs because we are not able to produce timely and adequate management information.

In summary, I know ever since I came to Union College, that an on-line system would give the College a new dimension of flexibility to meet its various internal and external responsibilities. In my opinion, the greatest benefit to the college to be derived from the new system will be the intangible results achieved through more efficient and effective administrative control of the institutional resources.

I am confident that baring any major change in our mission, we can expect the system to be adequate for our needs for at least five years and most probably much longer.

A STUDENT INFORMATION SYSTEM FROM CONCEPT TO CONTRACT

Tim Flynt
SIS Project Leader
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The University of Chicago is about to install a turnkey minicomputer system for its Student Information System. A project team, made up of users and Computation Center management personnel, studied problems and needs, reviewed alternatives, and recommended a solution.

This paper briefly describes the current University of Chicago system. It then examines the features wanted, the approach taken in finding the best way to get those features, and the categories considered.

Finally, the selected package (MSL/Campus) is described with emphasis on the points which made it attractive.

ENVIRONMENT AND CHOICES

The University of Chicago expects to have Phase I (Registration and Billing modules) operational within the next six months. How the University has moved from a concept to that six month schedule (and beyond), and how implementation is to be done are the subjects of this paper.

University Background

The University of Chicago's academic structure consists of eleven academic units which include: its College, graduate divisions, and professional schools. Each of the academic units operates with considerable autonomy. There is a Dean and a Dean of Students for each. The Dean of Students of each academic unit is responsible for the administrative life of students and reports jointly to the Dean of the unit and to the University Dean of Students. Each academic unit essentially collects and processes all admission, financial aid, and registration information for its own purposes. In addition, there is a central Registrar's Office which is responsible for reporting who is registered for what and for the preparation of all materials based on registration and beyond. As you can begin to see, some necessary duplication of data and effort is created by the decentralized structure.

Some five years ago, a committee was formed to begin investigation of a centralized student information system (SIS). The only automated system in operation at that time was - and still is - an IBM 1401-based tape system for the Registrar's Office. While the design was quite adequate for reporting then, over the years the approach has become burdensome. Running the system in emulation mode on an IBM 370/168 has not solved problems of cumbersome and slow processing procedures nor has it addressed growing reporting requirements. The University has recognized the need for a single, comprehensive system. Within the last 2 1/2 years, the University has considered several approaches to finding such an information system.

Alternatives Considered

- Inhouse development on the existing mainframe (IBM 370/168)
- Package installation on the existing mainframe
  - From another institution
  - From a commercial vendor
- Joint development with a vendor
- Package installation on an additional computer

Everyone concerned liked the idea of a tailored design. But as the real costs became known, few people were prepared to accept the associated costs or length of time for inhouse development in order to have that tailored design. Next best seemed the idea of installing a package on the existing computer. How nice it would be to transport the perfect system from a similar university and have it be operational -- and at very low cost... If not from another university, at least commercial vendors might have a transportable system which could be modified to meet the University's needs. Alas, no perfect match seemed to exist and, again, the questions of costs and time made this second approach unattractive.

As the review of internal requirements and their match with packages continued, the possibility of a joint venture of design, development and implementation with a major vendor was considered. An internal work force met with a complement of representatives from such a vendor and arrived at a possible approach at such a joint venture. Without beginning to consider costs, the approach was rejected because of the time it would require to get started.

The final category consisted of the installation of a standalone, turnkey operation. At first, this category of vendors seemed large. As contacts were made with possible suppliers, the number quickly dwindled as the University's requirements were described or as the supplier's inexperience with the environment became apparent. It was, however, from this category of "package installation on an additional computer" that the package to be implemented was chosen.

Online versus Batch

Since the University wishes to make a giant leap toward a comprehensive, online student information system, a strictly batch processing package is not desirable. Though there are certain unalterable parts of student information (class lists and grade reports for example) which are apt to remain as batch processes, one of the principal advantages of the system chosen for this project is the ability to maintain up-to-date data in all modules with less reliance on batch reports.

The Alternative Selected

The MSL/Campus package is intended as a complete administrative package for small colleges. It consists of some 20+ modules, of which about 10 are needed to support a student information system. The remaining modules are for a financial system. The package is written expressly for the Microdata minicomputer systems known as Royale (formerly called Reality). The package utilizes the data base and data base management tools which are incorporated in the Microdata operating system and supplements those tools with programs written in Basic. The inquiry tool (called English) is one of the more attractive features of the minicomputer; it is simple to use and can access not only elements of data within a given module but also can access elements from other modules.

OVERVIEW OF SYSTEM DESIGN

Briefly, records enter the system from outside source materials (machine-readable) or via manual, online entry into the Prospect File. At some later point, a batch program selects records from the Prospect File and passes them to an Applicant File. A permanent identification number is automatically assigned by the system at that point. As additional applicant information is received it is manually entered online into the system. At some point, another batch program selects records from the Applicant File and passes them to a Student File which is the primary source of information related to the student from that point forward. Prospect and Applicant File records may be purged, while the Student File is maintained for any future reference.

As students register, tuition billing information is automatically passed to Accounts Receivable and General Ledger Files. As financial aid and housing information are entered into the system, the Accounts Receivable and General Ledger Files are updated. Bills are created for any specified group of students. Receipt of monies is entered into the Accounts Receivable and General Ledger Files. As registration changes are made, updates are automatically made to the amounts of tuition and fees which a student owes and adjusted bills may be created.

Admissions Module

Using machine-readable data from CEEB, a batch program creates a Prospect File record for each prospective student; changes in address or other information are entered online. Lists and labels are produced for any selected category of prospective students. When enough applicant responses have been received, a batch program transfers selected records to the Applicant File, after which the Prospect File is purged in part or whole. At this point, a permanent student number is assigned by the system.

The Applicant File is manually updated as the admission status of each applicant changes. Lists and labels are produced for any selected category of applicants to aid in the decision-making process and to communicate the decision to applicants. Prior to registration, a batch program transfers selected records to the Student File.

Registration Module

Registration information is entered into the system and updated manually online. In order to speed the process of registration proper, updates of demographic information are delayed by a few days in order to concentrate on registration data entry. The input of registration data takes about 20 hours of entry time and uses 5 terminals. Allowing for interruptions, the 4 hours of entry time per terminal are completed over a 5-day period. Changes in course load which affect billing are automatically sent to the Accounts Receivable and General Ledger Files. Reports of enrollment are made at any time with essentially any selection criteria. There are the usual production runs of class lists, notification of status to the Veterans' Administration, grade reports, convocation rosters, and transcripts among the many requests for information from the Registration module. The most noteworthy departure from tradition is the maintenance of transcripts online and the production of a printed version only on demand.

Billing Module

Perhaps more properly called billing and student accounts receivable, this module receives data from the Registration, Financial Aid, and Housing modules. Transactions from those modules go to the Accounts Receivable and General Ledger Files.

Payment information from cash or credit vouchers is recorded in both of these files at the same time. The Bursar has the ability to inquire into the status of any student's record individually or by category and may request bills on the same basis. On a periodic basis, the General Ledger File is passed to the University financial system for transfer into the actual general ledger accounts.

Housing Module

The Housing module tracks the location of students living in University housing as room assignments are made online. The fees for a particular room within a housing unit are stored within the system and used to determine the billing amount which is passed into the Accounts Receivable File by a batch program.

Financial Aid Module

The Financial Aid module accepts manual input about the financial status of a student and prepares guidelines for preparation of awards. A primary benefit is the coordination of information from the University's payroll system, gift aid information from the academic units, and loan information from two centralized offices. The financial aid award information is sent to the Accounts Receivable File in order to show offsets to the student bill where that is appropriate.

Placement Module

The Placement module accepts manual input of career interest information which the student has supplied. That data is matched against the student's records and used to locate students with appropriate qualifications and interests for particular placement openings.

Alumni Interface Module

Information about departing students is selected and passed on to the current alumni system in an automated fashion with resulting information which is more accurate and timely.

IMPLEMENTATION PLAN

The project is divided into two phases. The first phase is the implementation of the base computer equipment and the Registration and Billing modules. The timetable is as follows:

Phase I

- Jan - Install minicomputer and unmodified software
- Feb - Begin data conversion
- Mar - Begin training and finalize data conversion
- Apr - Install modified Registration module
- May - Install modified Billing module
- Jun - Review project status

Phase II

- Jul - Install additional hardware equipment
- Aug - Finalize Financial Aid module specifications
- Sep - Install modified Financial Aid module
- Oct - Finalize Housing module
- Nov - Install modified Housing module
- The remainder (Placement, Alumni Interface, and Admissions modules) are to be completed by April 1980

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Since the implementation of these two phases is to occur primarily within the central administration building, the various academic units will not have direct access to the system. It seems reasonable that, after concluding the contractual agreement with the vendor, the University will schedule a third phase to extend the system to all academic areas.

Cost

The cost of the student information system project over a five year period, including purchase of hardware and software, maintenance, personnel in support of the system, and operation of the system, comes to under $1 million. The purchase price for the application software is about $110,000 and the fully expanded 30+ terminal network minicomputer system is about $300,000.

WHY THE U of C CHOSE MSL/CAMPUS

A "short" implementation period

You would expect that the University, having spent some five years in anticipation of a system, might be anxious to have its comphrehensive system needs met as quickly as possible. Certainly that is one aspect of the desire for a short implementation period. The more practical concern, though, is that growing demands for reporting information - both internally and externally - are overtaxing the current system. An 18-month implementation period, for all the modules described, seems quite short in comparison to the implementation periods of other systems at the University.

A data base management system

The data base management system contained in the Microdata minicomputer is well integrated into the operating system and has an easy to use data base query language. Most importantly, the MSL/Campus software package is written for and operates with the data base management system.

Online input, query, and update capabilities

An online system offers the advantage of faster access to data, generally at a higher cost than batch. Where the advantages of speed and control of data can justify the increased cost, it is reasonable to want all online capabilities. Not only does the University want online capabilities, but the costs for the online system chosen are less than those of the best batch system proposed.

Integrated modules

As the University has seen systems develop without an integrated plan, it has seen the final costs of development of initial systems and the later costs of integrating them rise to much more than the costs of starting with a single, integrated system. To avoid developing a set of individual modules and then redoing all or parts of them to let them communicate with each other, the University sought a package in which all of the parts were designed with integration in mind.

A cost/effective system

Not to abuse the term "cost/effective" in this paper, let us say that the University sought a system which would be effective in processing student information and which would be "reasonable" in cost - both initial and production costs. Detailed comparisons of costs for a final set of alternative packages did suggest that the turnkey, minicomputer package approach would be "cost/effective." The University expects to gain a maximum amount of use from a system which costs less than the projected development costs alone for an internal system on existing equipment.

STUDENT INFORMATION MANAGEMENT SYSTEM (INFO)

Raymond E. Whiteman

Spring Arbor College

Spring Arbor, Michigan

The INFO student information management system is designed to follow a student through a college or university from the time of the first inquiry to the alumni file. It is marketed primarily for smaller colleges and universities. Spring Arbor College was selected as the pilot college for the initial installation and writing of the software. This paper will briefly describe the operation of the system as we have experienced it.

Spring Arbor College is a four-year liberal arts college affiliated with the Free Methodist Church of North America. Its enrollment has been between 800 and 900 students for the past five years. The student body consists primarily of fulltime resident students. There are 40 fulltime faculty. The college is an undergraduate institution offering the bachelor of arts degree with majors in 16 areas.

For several years, the only computer use on campus was by the Registrar's Office for producing class lists, grade reports, transcript labels, and a few related reports. An IBM computer system on another campus was utilized for these through a card batch process. With an increasing need to collect, store and produce data in other areas of the campus, consideration was given to expanding our computer operations. An IBM System 32 was leased and a student was hired parttime to begin work with various campus personnel in determining how their needs could be better met through the computer system.

After a few months, the college was approached about the possibility of purchasing a complete student information management system called INFO from College Services Corporation. We were to be the pilot college for the system and would, therefore, be involved in considerable planning before the system would be operable for us. After careful consideration we decided to make the change. Because the system had already been partially designed for another college and was operable on Datapoint hardware, we purchased a processor, two disk drives, a belt printer, and four terminals from Datapoint Corporation.

For several weeks we worked closely with the programmers to develop a system which would meet our needs and still be general enough to be easily adaptable to other colleges as well. After the hardware was installed, many more weeks were spent testing and modifying programs. Since our equipment and part of the software package arrived in late spring, we were able to use our summer school program for trying out parts of the system. Today, after 18 months, there are a few remaining modifications to make, however, the entire system is basically in full operation.

There are five main areas or offices on campus incorporated into the system - admission, financial aids, registration and grading, business affairs, and development. The system was purchased mainly for administrative use and thus no computer classes are using it. Another mini-computer is used for instructional purposes. Two additional terminals were purchased giving each area noted above one terminal plus one for the data processing office.

INFO is programmed in the Databus language which the equipment is primarily designed for, however, it can be converted to other languages. The system's Datashare feature allows up to 16 terminals to be in operation at one time. The major areas and files of the INFO interact with each other in several operations. For example, when the registrar's office registers a student, the program looks for the student in the current student file, in the admissions file, and in the former student file. If found in the former student file or in the admissions file, the data will be transferred to the current student file. If the student has a balance due in the business office, it will be noted to the person registering the student so that the process can be stopped if desired.

The system has greatly increased the speed at which various operations can be done and opened up countless numbers of lists by specific criteria that can be produced. At the same time it has made more time available to spend on other areas other than collecting data and producing reports. Since I am primarily concerned with the registrar's operation, and since this is an area of concern in most colleges in terms of whether to put the office on computer or not, a closer look at this area would be helpful.

The registration and grading segment of the package includes around 40 programs with some being registration of courses and fees, production of schedule/invoices, class rosters, grade rosters, report cards, transcripts, student locators, advisor lists, rank-in-class lists, and grade distribution listings. By having a preregistration process, one terminal can easily handle all of our entry needs. We can service all parts of the campus community by providing lists for classes, clubs, publications, etc. While our ability to service the campus community has increased, we have been able to reduce personnel. The current staff in the Registrar's office includes a fulltime registrar, who also has other duties, and two parttime secretaries. Some student help is also used a few hours a week.

Now that INFO is fairly well in operation, the data processing center has a staff of one half-time person. When he is not on campus, the registrar's office personnel can assist the other campus offices.

While there have been many frustrations in getting the system established, today we are generally very pleased with its capabilities. Most of our frustrations occurred in the early stages of being the pilot college for the system. Some of the difficult problems have been those which would be encountered with any system, namely, getting people to accept it and to understand its uses and limitations. The ease of which the system operates allows personnel to use it accurately and efficiently with only a few minutes of instruction. The problems, however, come in determining how to adapt the system to office procedures which have been used for many years. It is imperative that good communication and instructions be generated between the office users and the data processing personnel.

QUODATA Management Package Use by a Small College Consortium

Dr. John J. Jackobs
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CMC Colleges Associated was formed to purchase and operate a single computer system to serve the academic and administrative needs of three colleges (Coe, Cornell and Mt. Mercy) in the Cedar Rapids-Mt. Vernon Iowa area. The QUODATA Management System for DEC PDP 11's from Quodata Corporation has provided non-technical users access to their data when they need it. Within six months of installation, extensive use of admissions and alumni data are being made by those respective areas of the consortium colleges. The offices maintain the data and generate reports to serve their respective operations. The report generator is interactive and asks questions in a non-technical manner and gives users immediate access to their data.

QUODATA Management Package Use by a Small College Consortium

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CMC Colleges Associated is an Iowa eduactional consortium formed initially to operate a computer system to service the academic and administrative needs of three colleges in the Cedar Rapids - Mt. Vernon, Iowa area. The three colleges are Coe College, Cornell College and Mount Mercy College, all private 4-year liberal arts colleges.

Coe College is located near the downtown area of Cedar Rapids and has a student population of 1243. Coe College's academic calendar is 4-1-4 with two summer sessions.

Cornell College is located in Mt. Vernon, Iowa 14 miles from Cedar Rapids in beautiful rural Iowa and has a student population of 880. Cornell College's academic calendar is One-Course-At-A-Time or a 9 term year.

Mt. Mercy college is located 2 miles from downtown Cedar Rapids on a hill overlooking Cedar Rapids and much of the surrounding area. Mt. Mercy College's academic calendar is 4-1-4 with 2 summer sessions. Mt. Mercy has a student population of 1015.

In 1976 a study was begun looking at the computer needs of Coe College. Solutions to the problem of inadequate computer facilities to handle increasing academic and administrative data processing, ranged from enhancing the present IBM 1130 system to a shared computer system. Cornell College also has an IBM 1130, Mt. Mercy College did not have a computer system. Upon completion of the study which involved all three colleges, a shared computer system was proposed which gives each college more computer capability than any one college would be able to afford by itself. The benefits are:

1-Sharing of computer expertise among all three schools, especially among the academic departments.

2-Sharing software packages, in this case only one package is required to service all three colleges, if each elects to use the package.

3-The financial savings, as the system costs are shared by the three colleges, each paying less than if individual computer systems had been purchased.

The computer system proposal was presented to a local Cedar Rapids group, the Hall Foundation. After considerable negotiations, a grant of $340,000 was given to the consortium to purchase the initial hardware/software and maintain and operate the system for one year.

A Digital Equipment Corporation PDP-11/70 was purchased with a configuration of 256K bytes of ECC memory, 2-RM03 (67 Mbytes) disks, 1-magnetic tape drive, 1-high speed printer, card reader, 1-LS120 (DECWriter III), 10-LA36 (DECWriter II), 11-Hazeltine Mod One CRT's, 12 Hazeltine 1500 CRT's, 2-plotters, 2-Diablo 1620 terminals and CODEX 16-channel time division multiplexers to handle the telecommunications between the three colleges. The computer system was put together by Quodata Corporation, 196 Trumbull Street, Hartford, CT. The software with the system includes the RSTS/E operating system, BASIC-PLUS, Fortran and QDMS, the Quodata Management System. We have also recently purchased the SPSS package for the PDP-11 through Carleton College.

The computer staff is small and is comprised of a Technical Director to coordinate implementation of administrative systems on the computer and the computer center directors from the three colleges, who primarily coordinate matters of academic concern. A Computer Policies Committee meets regularily to formulate and recommend policies and procedures to be implemented in operating the shared computer system. Each college has two voting members on this committee. A monthly newsletter to all faculty and staff on the three colleges provides additional avenues of communication and sharing of resources. Workshops are also conducted on the three campuses providing opportunities to learn about the capabilities of the computer system or to refine use of some particular software package on the computer.

With the small staff and the need to bring up administrative systems quickly a data mamagement package was required. Quodata Corporation is marketing such a package for the DEC PDP-11's under the name QDMS. It follows the computer center's philosophy of bringing the computer to the users through its on-line capabilities. This allows each user to maintain and use their data whenever and however they require. The user is this case becomes totally responsible for the integrity of the data. Through the report generation features, extensive custom programming is eliminated which seriously delays the time between report request and report generation.

In the five months of operation we have implemented and turned over to the Admissions Offices at each college an on-line student inquiry system. At one of the colleges (Mt. Mercy) we have implemented a skeleton alumni file which now has on-line query and update capabilities. When the final alumni file configuration is completed, the skeleton file information will be moved to the new file through the BATCH add option in the QDMS package.

Implementing QDMS files which have common definitions is the responsibility of the Systems Manager.

Let's take the Admissions Office procedure as an example, similar proceedings are taking place for the other administrative offices.

A preliminary document was issued to each Admission Office asking them to appoint a representative from their office to participate in the formation of the data file. Included was a list of suggested items for the file. The participants were asked to bring to a meeting, modifications, expansions of the list for discussion. From this meeting and two more which were to follow, the list of items, the dictionary, was finalized, providing each college with all of the items they wished to use in their operations. These meetings provided the common dictionary as well as provided an opportunity for the three Admission Offices to exchange ideas with one another. Once the dictionary elements were settled upon, the system was ready for computer implementation.

Three steps are required in QDMS to prepare the files for use by the respective administrative offices, they are (in QDMS terms) CONFIGURE, DESCRIBE and ALLOCATE.

From the managers account which has been setup to access other accounts, I configure or inform the QDMS system where and what names will be used to reference the various files required by the data management system. To eliminate unnessary confusion and possible file destruction, permission is not given within these newly formed accounts to CONFIGURE, DESCRIBE or ALLOCATE other accounts. Through the question and answer session the attributes given to the Admission accounts are completed in less than 10 minutes. This configuration file resides in the target account and thus controls the access granted to that account. If only one file is accounted for, then anyone wishing into the target account has access to only this one data file. Attempts to enter or use data in some other account will lead to the termination of the job and the data management system will sign the user off the computer system.

From the same managers account, the attributes of the records within the file are described through the command DESCRIBE. Of all the parts of QDMS available to the user, DESCRIBE is the only section which requires one to have had some experience or knowledge of computer systems. To take full advantage of the capabilities of the operating system, record restrictions and blocking considerations, one has to be familar with the way information is stored on the system. QDMS gives the user a full range of options by which to store and compact data. Seven modes of storing data are available and depending on the information to be stored one can minimize the storage required to handle the data. Once the decision has been made as to where the data will be stored and how it will be stored, the user need no longer be concerned as QDMS will take care of the packing and unpacking of the data as it enters and leaves the system in all subsequent use of the data managment package. For the Admissions Inquiry systems, it required about 45 minutes to decsribe each of the files for the three collebes. There are many defaults if one elects not to assign limits or other default values which speeds the description process. In the Admissions systems now operating, there are 61 items available for use in the respective offices. The DESCRIBE command allows one to modify selected items of the description without having to redescribe the entire file. For documentation a LIST option is available and as many copies as necessary can be distributed so everyone using the management system will have a full set of documentation.

Once the file has been described one then knows the record length and the ALLOCATE command is used. The manager again executes this command because a small error could result in too little or too much space to be reserved for the file. With the allocation procedure a 5 minute or less session is all that is required. One answers a few straight forward questions; the number of records in the file, the logical record size and the manner in which the information will be stored on the disk (in RSTS/E terms - the clustersize) or the blocking factor. When the allocation process is complete, the file is ready for use,ie., the owner of the file may begin immediately to add data on-line to the file.

I would now like to go over the major user interaction commands. They are ADD, DELETE, CHANGE, INQUIRE, SORT and REPORT. In addition to these commands is a set of utility commands which makes life easier for the system manager and keeps the computerese to a minimum for the administrative user. These utilities include the following by name:

EBCDIC - to convert an EBCDIC tape to an ASCII file.

PDQRPT - a report generator to produce quick one line/record reports.

LFN - to assign logical names to data files.

VFORMAT- allow one to format the screen on a Hazeltine Mod One crt and to make optimum use of the editing capabilities of the crt.

ACCOUNT- to provide statistics about the various data files configured to this account.

LIST - a general listing program to transfer information from one device to another.

VDU - a program to logically keep track of those terminals using the editing options of the Hazeltine terminals.

A one page sheet is given to the new user to explain how one signs on the computer system and gains entry to the management system. On this sheet is briefly explained the major user commands available and the general set of options which can be used with each of the commands. Appended to this sheet are sample runs using their data files so they can see the layout as the questions are asked, especially what the recommended responses should be. So far I have been able to use these run sheets with administrative staffs who have had no previous computer experience. The Admission staff at Coe college has so far had 3 sessions, each lasting from one to 1 1/2 hours. We will go throgh the commands using actual data which is to be put into the file. Sessions after the first, I feel have been the most productive because the people have had a chance to use the system even if they have followed a sample run very closely. They ask the 'what if' variety question rather than no questions at all. The intent at Coe College and Mt. Mercy College is to have every member of the staff trained to use all functions of the data management system.

The major user commands begin with the ADD. Here QDMS gives the user an option of on-line addition or batch addition. For Coe and Cornell Colleges since the inquiry systems were on the IBM 1130 systems, the card decks were batched directly into the QDMS files. Once the data re in the files, the respective offices began maintaining their own files through the on-line options available.

For on-line ADD one begins by specifying what record elements will be added at this session. The staff will generally work from source documents and will not have all elements available so this selective add is quite useful. Of the 61 elements in each record about 25 are initialized when the record is added. After specifying, the records are then built from the elements selected. An option available here is a repeat function. If several records have elements in common, these elements can be repeated from record to record until the user specifies a different value. Also while building their record an option exists which allows the user to go back and change elements before the record is sent to be added to the file. Upon specifying all elements of the record the user has a chance to have the system echo back all the information given before adding the record. The record is added and the user is asked if more are to be added, if not an index is quickly built and control is returned to the DISPATCHER for further file processing or termination of the session. Records in the Coe Admissions file are added in 3-4 seconds (there are in excess of 18,000 records each of 170 bytes).

The DELETE command allows the user to purge from the file those records no longer needed. The record is specified by the keyfield or keyfields. The system has the user reconfirm the desire to delete a particular record. The user continues to specify records to be deleted until all have been taken care of. At this time a pointer file is quickly built as in the ADD option and control is again returned to the DISPATCHER.

To modify an element within a record, the CHANGE command is used. The user again uses the keyfield(s) to specify the record desired and then specifies the element to be changed - by name and not by number. The change is made and echoed by the system for verification. Changes are made as fast as one can call up the records and specify the elements.

The INQUIRE command allows the user to look at any record and element within the record, but not change any of the information. In the DESCRIBE command explained earlier, as one assigns the element attributes, read and write protects can be added, so users can be restricted as to what data are displayed. The records are accessible to the user in the time necessary to retrieve the record from the file. As the Coe Admissions staff uses this option, after the mail arrives, the inquiries are checked to see if they are already in the file and processed through the office accordingly. This option alone has saved considerable time over the manual search which was performed prior to the on-line system.

The SORT command allows the user to specify a subset of the main file to be used by the report writers later or for any other purpose, such as a special application. The SORT generates a pointer file which is stored on the disk. One can name as many of these pointer files as necessary to accomplish the tasks at hand. Several quesstions are asked of the user necessary to define the pointer or index one is generating. Then the sort fields are specified, followed by the selection options if there are any. Prior to entering the sort some time should be taken to define clearly the selection criteria before sitting down, on-line, to make the specifications. Once the selections are made the extraction and sorting begins and takes care of itself and exiting to the DISPATCHER when the selecting and sorting are completed.

The REPORT command uses the pointer file generated by the SORT command to produce a report necessary to answer the questions at hand. Again a series of questions are asked leading the user through the report generation and format process without having to know a lot about the computer system. It is expected in the near future users will specify and print locally the needed reports. Additional workshops will be presented so maximum use of the report generators can be used without having to call upon the computer center staff to set up all the details as is done currently on the IBM 1130 system.

Within the commands DELETE, CHANGE and INQUIRE are a set of functions which give the user a great amount of flexibility when looking at the records.

The GET functions on the keyfields to obtain the record one wishes to look at. By specifying the function name GET, the field name and an operand, the user calls up a record. If there are more than one keyfields the sequence - field name, operand can be chained in one command. An example would be looking for John Smith, to GET on Smith only would obtain the first of the Smiths. To walk one's way through the Smith's or any part of the file the function NEXT is used.

The NEXT function will obtain the following record in the ordered file if no operand is given with the function. An operand of a positive or negative value may be used with NEXT to skip a group of records following or preceeding the last record obtained.

To display the contents of a record the SHOW function is used. The operands following the SHOW are the field names of the record elements one wishes to display. The user has the option of displaying as many or as few of the fields as necessary. The fields displayed will remain constant until the execution of another SHOW function. When the editing options of the Hazeltine Mod One terminals are used, the screen format dictates the elements displayed. A variety of screens can be configured to meet the needs of the user. The user determines the screen to be displayed thus controlling the informtion requested from each record obtained. Currently we are not using the editing options. After the various users have settled on the most frequently changed items, we will then format screens for them, for then they will determine the elements of the record to be displayed.

The space is used as a default separator between functions and operands. One can imagine the difficulties which can arise in interpretation of functions and field information which contain blanks such as street and city information. The MARK function is available to correct this difficulty. The MARK changes the delimiter character which will be used from that point on to separate functions and operands. The delimiter character can be changed by issueing another MARK command.

At any time one can issue the HELP function which displays the functions available with the command and a brief statement as to their use. This is convenient for use with the crt's as one may forget what command is in control and the HELP refreshes the user's information as to what functions are currently available.

The CHANGE function is available only with the CHANGE command. Here the user specifies the record to be obtained and displayed and then with the CHANGE function the field to be altered followed by the new information. The new information is then available for use if someone else is also using one of the commands which does not alter the contents of the file. The CHANGE function echoes the information for the users visual verification.

The DELETE function is operational only with the previously mentioned DELETE command. The user obtains the desired record through the GET and SHOW functions and when satisfied this is the correct record issues the DELETE option. The system asks for verification before deleting the record, this gives the user a chance to rescind the command.

The LOAD function allows the user to define the file with another index file. Thus different users may be responsible for differnet portions of the data and use of special index files gives each exclusive access to their portion of the file.

The elements of the Quodata Management System have:

1-Allowed rapid training of users.

2-Brought the users data to the user and given immediate access.

3-Made the user totally responsible for the accuracy and integrity of the data file.

4-Allowed the user to input the dta directly from source documents.

5-Brought computerization to the user in their language, English and not required them to learn a 'new' language to be able to access their data.

CMC Colleges Associated has been able to bring up two major administrative systems, Admissions and Alumni within 5 months of installation of the computer. A Financial Reporting System has been obtained from Quodata Corporation and will be implemented within the next 3 months. Again the same procedure of defining common dictionary elements for the three colleges will be used. We are pleased with the ease the users have been able to use the system. The change of attitude of users is the most gratifying expression of success. I have seen attitudes change from 'I'll never be able to learn' one week, to 'what else can we do with our data' the following week.

MULTI-INSTITUTIONAL OPERATION OF A COMPUTING CENTER

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For the past twelve years six colleges in central Kansas have been operating a cooperative computing center to provide a full range of services including academic, research, and administrative information systems. This paper will describe the organizational arrangements of the Associated Colleges of Central Kansas (ACCK) which is a consortium chartered as a corporation to provide legal entity in which the computing center operates.

MULTI-INSTITUTIONAL OPERATION OF A COMPUTING CENTER

The importance of computing in higher education is widely recognized; there are over 3,000 computers now installed in higher education institutions in the United States and cost more than a half a billion dollars per year to operate. These figures do not include the burgeoning number of micro-computers. Administrations and faculties of colleges and universities across the country realize there are many potential benefits that can result from information processing and instructional applications of computing resources. It is also true that these computing resources cost a great deal of money.

THE CONSORTIUM

The Associated Colleges of Central Kansas (ACCK) represents a way in which several small colleges in the midwest are providing computing services for themselves through an interinstitutional computing center to an extent that each college individually would not be able to afford. While these colleges are small, many of the issues they face in the operation of a cooperative computing center are common to much larger organizations. This presentation is a description of the operation of ACCK's computing center along with observations on the strengths and weaknesses of the interinstitutional arrangement.

The Associated Colleges of Central Kansas is a consortium of six private four-year liberal arts church related colleges (Bethany College at Lindsborg, Bethel College at North Newton, Kansas Wesleyan at Salina, McPherson College at McPherson, Sterling College at Sterling, and Tabor College at Hillsboro). These colleges are similar in their missions, goals, and curricula. Average enrollment for each college is around 600 students. They are all located within a thirty-five mile radius of McPherson, Kansas.

ACCK was established in 1966 to "(a) advance the interests and contribute to the educational effectiveness of its member institutions; (b) to develop and assist the member institutions in improving the efficiency of their operations both administratively and culturally; and (c) to assist the member institutions in developing additional sources of revenue." Since the establishment of the consortium the six member colleges have adopted a common 4-1-4 academic calendar, implemented cross-registration, and encouraged faculty exchanges among the colleges.

Through the years ACCK has developed and coordinated many cooperative programs. The largest on-going program and one which has been a part of the consortium since its beginning is the computing center. Programs of the ACCK are developed and administered by a central consortium office located in McPherson, Kansas which is staffed by an executive director, business manager, and secretarial staff. As cooperative programs are developed additional staff are appointed to direct and manage them. Thus ACCK Computer Services, a program of the ACCK, is staffed by a director, and three other professionals. Other programs which have been coordinated by the ACCK in the past dozen years include mini-grants to academic committees, international relations education project, Upward Bound program, inter-library loans, cooperative special education curriculum, cooperative computer science curriculum, and visiting scholars. Some of these programs have existed for one or two years, others have been in operation for the entire history of the ACCK. The establishment of a special program depends upon the particular needs of the colleges at a given time and on the availability of funding to support the cooperative programs.

Communications is vital, one can almost say paramount, in any cooperative program. There are two main communication links which bind the ACCK; the first is a courier which makes the circuit of the six colleges Monday thru Friday carrying books and other materials for the inter-library loan program, data processing input and output for the computing center, and other inter-campus materials. The second avenue of communication is a telephone hotline which connects the switchboards of the six colleges.

ACCK was incorporated as a not for profit corporation in the state of Kansas in 1966. Under the terms of the articles of incorporation, ACCK has the power to acquire property, to borrow money, to invest and reinvest funds, to grant certificates, diplomas, and degrees, and to, in general, engage in other acts of support for the purposes of the corporation. The corporation is controlled by a board of directors. Each member institution is represented by two persons; one being the president of the college, the second being a member of the college's board of directors. As a practical matter, most policies are set by an executive committee made up of the six colleges presidents.

The organizational structure of the ACCK and the milieu of cooperative programs provide a strong supportive basis for the operation of a common computing center. There is no question that the longevity of ACCK computing services is partly a result of general cooperation among the six colleges.

At the present time essentially all computing services, both administrative and academic, are provided the colleges through the centrally located ACCK computing center. In developing the computing center, effort has been made to make available as broad a range of computing services as can be afforded. This has been one of the important factors determining choices made in developing the computer center over the past twelve years.

HARDWARE SYSTEMS

Currently, ACCK has installed a Harris S210 time-sharing computing system. Interactive terminals are installed at each campus and are connected to the host computer in McPherson via leased telephone lines. Batch services are provided via the ACCK courier. Diagrams of the system are shown in APPENDIX 1 and 2. APPENDIX 3 is a listing of some of the software services available on the system.

The current system is the third computer configuration in the history of ACCK. The first system, installed in 1967, was an IBM 1401 batch system. All processing, including administrative and academic work, was done via courier. Assembler code was used for administrative applications and FORTRAN was the main academic language.

In order to provide students with more reasonable access to the computer, a DEC PDP/8 BASIC timesharing system was installed in 1971. It supported one teletypewriter on each campus. Also in 1971 ACCK entered into an agreement with a local insurance company to lease third shift time on an IBM 370/145. COBOL became the main data processing language while academic computing was supported with batch COBOL and FORTRAN on the

IBM 370/145. Software packages such as SPSS and BMD were installed and made available to all users. However, the use of once a day courier to process programs written by students of COBOL and FORTRAN left much to be desired.

In 1975, in order to regain control of our computer operations, to provide better service to academic users, and to provide a basis for future development of administrative systems it was decided to install a new hardware system. The request for proposal which was circulated to computer vendors in 1975 indicated that ACCK wanted to support concurrent timesharing and batch processing, that all services should be available to interactive users at the colleges, that standard versions of at least the languages BASIC, FORTRAN, and COBOL should be provided, that special software packages such as SPSS continue to be supported, and that that existing administrative systems be converted from the 370/145 with minimal difficulty. The final choice was the Harris system which was installed in April, 1976. The main factors in the hardware choice were services supported, performance, and cost.

The installation of the computer system in 1976 was a test of commitment to cooperation on the part of the colleges. Not only were they committing themselves to the development of new software systems necessitated by new computing hardware but the installation itself required expanded office facilities to house computer equipment. The colleges decided to purchase the computer hardware and also to invest in office facilities by means of a bank note underwritten by the colleges themselves.

Throughout the years of ACCK's operation it has been assumed that six small colleges can cooperatively operate a computer system at a cost far below the operation of a comparable system by a single college. Many developments have occurred in computer hardware in the past decade; systems having the processing capacity of an IBM 1401 can now be purchased for less than $5,000. These developments have led some to question the advantages of operating a central computing facility. ACCK still believes that there are and will be economies of joint operation of a computer center but the issues and modes of operation are more complex than they have been. It may be that many services such as BASIC language instruction can be provided more economically via micro-computers. Perhaps certain types of data entry can be handled by micro systems which communicate with the main computer only several times a day. The cost of data communication has been increasing in the past few years and is an important variable that needs to be factored into any analysis of centralized versus distributed processing. On the other hand the economy of scale still seems to argue for centralized mass storage facilities, tape drives and libraries, line printers and card readers. The centralized computer management, system analysis, programming, and maintenance team of the ACCK continues to be a great deal more economical than if the colleges would attempt to provide such services on their own. Such services are required regardless of the type of hardware being used.

These are issues with which we are now struggling; to develop a coordinated system of dispersed microprocessors and a central computer facility will take all the skills and cooperative good-will that have been developed over the past several years.

ADMINISTRATIVE SYSTEM DEVELOPMENT

In a multi-institution computer center such as at ACCK an issue that arises again and again in the development of information systems is whether to develop a system for each college or to develop a comprehensive system that can be used by any of the colleges. Advantages of developing a unique system for each college include (a) the system can be tailored to meet the needs of the college and its decision-making processes and style, (b) systems and programs can be simpler because they are targeted to a single college, (c) design time is shortened because the analyst does not have to deal with as many persons in physically separated offices, and (d) maintenance is easier because changes do not need to be approved by many offices. In trying to develop systems for a group of colleges one soon learns that while one college may be psychologically and economically ready to move ahead to change aspects of their operation, another college may be on a planning and development plateau and relutant to make any changes. In this case the analyst must use the skills of a change agent. Reasons for developing comprehensive information systems include (a) the obvious fact that designing and developing one system uses fewer resources than developing n systems, (b) since the colleges are similar their information processing needs are similar although sometimes the analyst must point this out, (c) computer center operations are made easier because fewer systems need to be supported, (d) coordinated design and development should result in a better system because of the interaction of college administrators with each other, and (e) by acting in combination the group has greater resources with which to acquire software packages, programming staff, and other support.

Generally ACCK Computer Services has developed comprehensive systems that are used by any member college that wishes to use a particular system. Resources simply are not available to develop and operate independent systems for each college. In every comprehensive system ACCK has developed the colleges all use the same master file format although they may develop their own coding structures for various data elements. For example, each has its own chart of accounts and each has developed its own codes for religious preference. Many of the report programs are also individually adapted to particular colleges.

Over the years a wide range of administrative systems have been developed for the colleges by the computer center staff. Currently systems are providing services for alumni/development, admissions, general accounting, student records, payroll, national defense/direct loan collection, library union serials, and mail subscriptions.

Each of these systems has been developed in cooperation with the appropriate consortium committee of college representatives. Thus, for example, the student records system was developed in cooperation with the ACCK Registrars Committee and the payroll system was developed in cooperation with the ACCK Business Managers Committee. Each of the systems mentioned earlier has been developed and operates independently of other systems and all have been through at least two generations of development over the past twelve years.

Each of the systems has met the needs of users when it was first developed. However, when a particular college desires and plans to make a major change in its use of institutional data or office operations because of new administrators or because of recommendations by consultants or because of directives from their boards of directors the resulting requests for major systems changes present real problems for the computer center. The genuine need for improvement of systems requested by a single college must be balanced against resources available to the computer center and the need for a stable system by the other colleges. There can be no single solution to such dilemmas but a recognition that they will occur and the development of a consortium long range plan can help the computer center and the colleges deal with these problems when they arise.

Administrative systems have been sufficiently developed and college administrators have become sophisticated enough in ACCK to require planning for an integrated data system, one that will span all operations of the college. As plans are formulated for the development of an integrated system no longer, for example, can the registrars design their system independently of the business managers. Rather support for data base development must come from the consortium presidents and deans committee so the commitment to develop a comprehensive data system is made clear at the consortium level and also on each individual campus. This process creates an extensive task of communication and coordination and results in a rather lengthy process of decision-making. This is one of the overhead factors of a multi-institution computer center operation.

FINANCING

The computer center is financed in several ways. Part of the support for the computing center operation for the past twelve years has been from our HEW Title III program to aid developing institutions of higher education. This support has been primarily to aid in the development of automated data processing systems to improve college administration and to strengthen curricular offerings. The other major source of support is of course the colleges themselves who contribute a fixed equal annual assessment to the ACCK. A lesser source of support is the sale of services to outside agencies. ACCK's method of financing computer operations has the merit of being simple; however it does not set center priorities which results in several problems with which ACCK is struggling.

First is the dependence of ACCK on Title III funding. Continued dependence of administrative system operation on temporary funding has made it difficult to develop long-range plans. Support of the computing center should be moved from temporary funding programs. Second, the method of college support of the center through fixed equal assessments places the responsibility for the establishment of systems development priorities on the computer center staff and the computer policy advisory committee. When users can ask for services without having to face the responsibility of paying for these services directly, the establishment of priorities becomes difficult. It would seem that the combination of these two factors will lead the ACCK to some form of charge back for systems development and/or computer operations.

Current ACCK Computer Services expenditures including hardware, software, and staff is approximately 1% of the combined educational and general budgets of the six schools. Colleges the size of those in the ACCK would not be able to make available to various users the broad range of computing services without the cooperative programs of the ACCK at anywhere near this cost.

USER RELATIONS

Interesting changes have occured in the nature of computer operations over the past twelve years of operation. At first, most of the users of the computer -- a few highly motivated individuals, individuals who were commited to help develop administrative and academic computing services -- were intrigued by the computing system made available to them and made special efforts to become aware of the nature of services provided and either overlooked or worked around idiosyncrasies and shortcomings that may have been inherent in the hardware and software systems. As the use of both administrative and academic services has become more widespread in the colleges and as more personnel have become involved in the use of these services, the relationship between the computing center and users has changed. Comprehensive support of systems by the computer center must be provided to greater degree via documentation, personal visits, telephone consultation, and on-line prompting. Systems must be easy to understand, use and be robust. Users have become more demanding of computing services and rightly so. This has lead the colleges and the consortium to evaluate the quality of service being provided by the computing center, the capacity of the colleges to make effective use of computing services provided, and the perceptions of various user groups of the computing center.

As part of an effort to more effectively relate to computer users a survey of computing users was made this Fall. The survey asked various users to respond on a negative to positive scale to 38 statements about the computing center and the services it is providing. Briefly, the survey indicated that users were in general tolerant of the computing system and computer center staff, but they wanted to be shown how to more effectively use the systems through consultations, documentation, training sessions, etc. They also wanted to be able to have input on decisions concerning system priorities.

So it has become clear that users must be supported to a greater extent. For all practical purposes the computer center staff in McPherson has been the only computing center for each college up to this time because some of our colleges have very little computer expertise on their own campus. With the increased dependency of the colleges on computer services this arrangement will no longer suffice. Each college should create a position of computing services coordinator or director; a person who would be the focus and coordinator of computing services for users at the college. This person would be an extension of the ACCK Computer Services staff on the campus and at the same time a representative of users to the ACCK computer center staff.

In conclusion, a study for the Ohio Board of Regents suggests some guidelines for computing resource sharing:

1. Parties must do a thorough job of spelling out financial support, policies, etc., before startup. The maximum cooperation of the participating institutions is a necessity.

2. There must be strong central management of hardware and systems software.

3. A computer consortium increases efficiency without increased costs because of:

    a. cheaper computer cycles
    b. cheaper or larger quantities of disk storage
    c. faster response or shorter turnaround time
    d. availability of special resources
    e. availability of a large variety of languages
    f. availability of packages to perform particular functions

4. Success depends upon the administration of the enterprise. The administration must have the goal of providing service to the greatest number of participants possible.

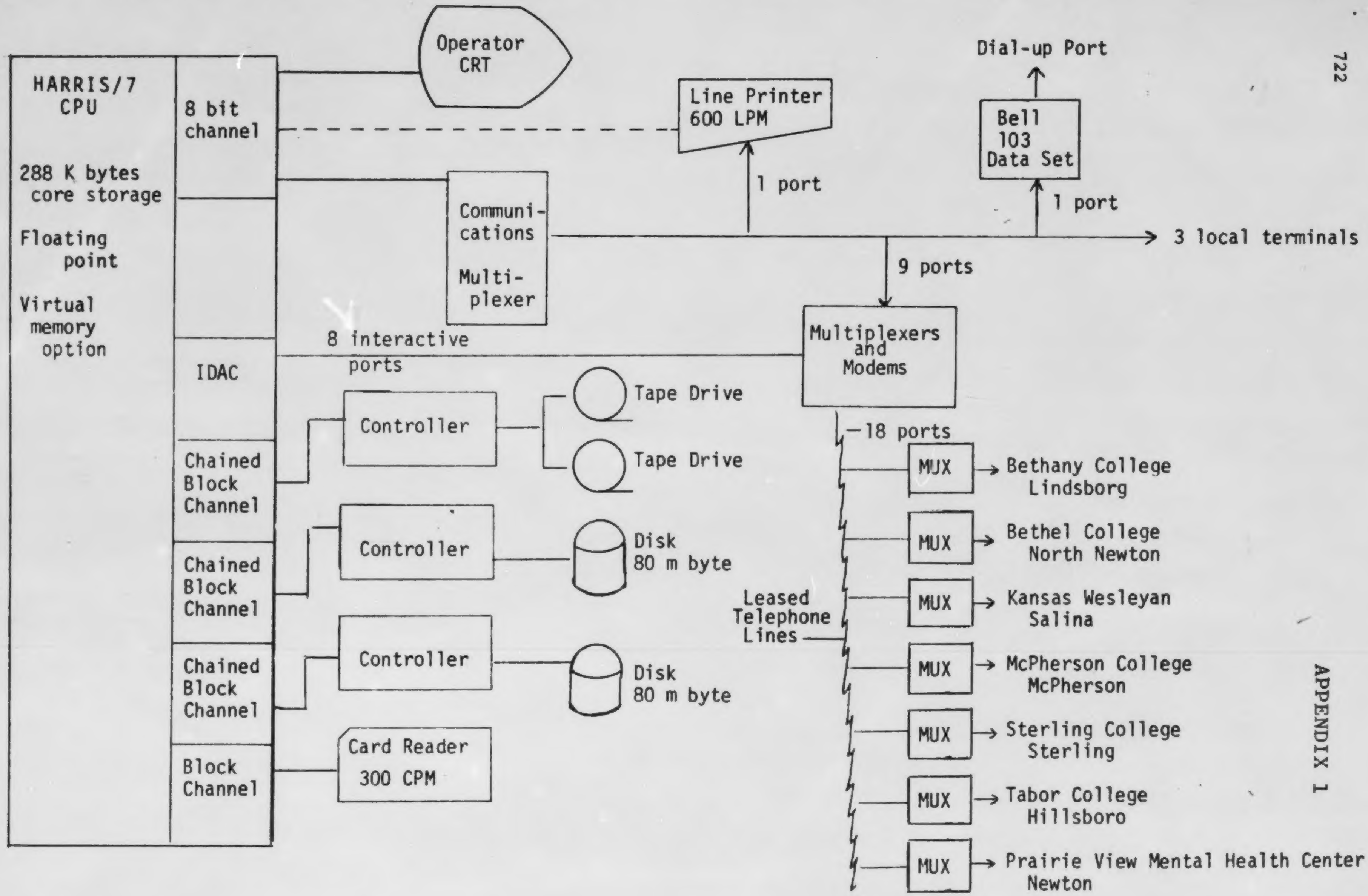
5. A proper long-range of at least five years must be developed prior to the formation of the facility.

6. The plan must clearly identify the venture as a financial enterprise totally separate from the participating institutions, yet meeting each institution's needs.

7. The document that creates the entity must define an organizational structure and provide a related budget to totally support the entity as a service operation.
8. The concept of marketing is essential.
9. Each institution must be sold on the concept of the center; autonomy must be bargained away with advantages.
10. The concept of customer service is fundamental to success.

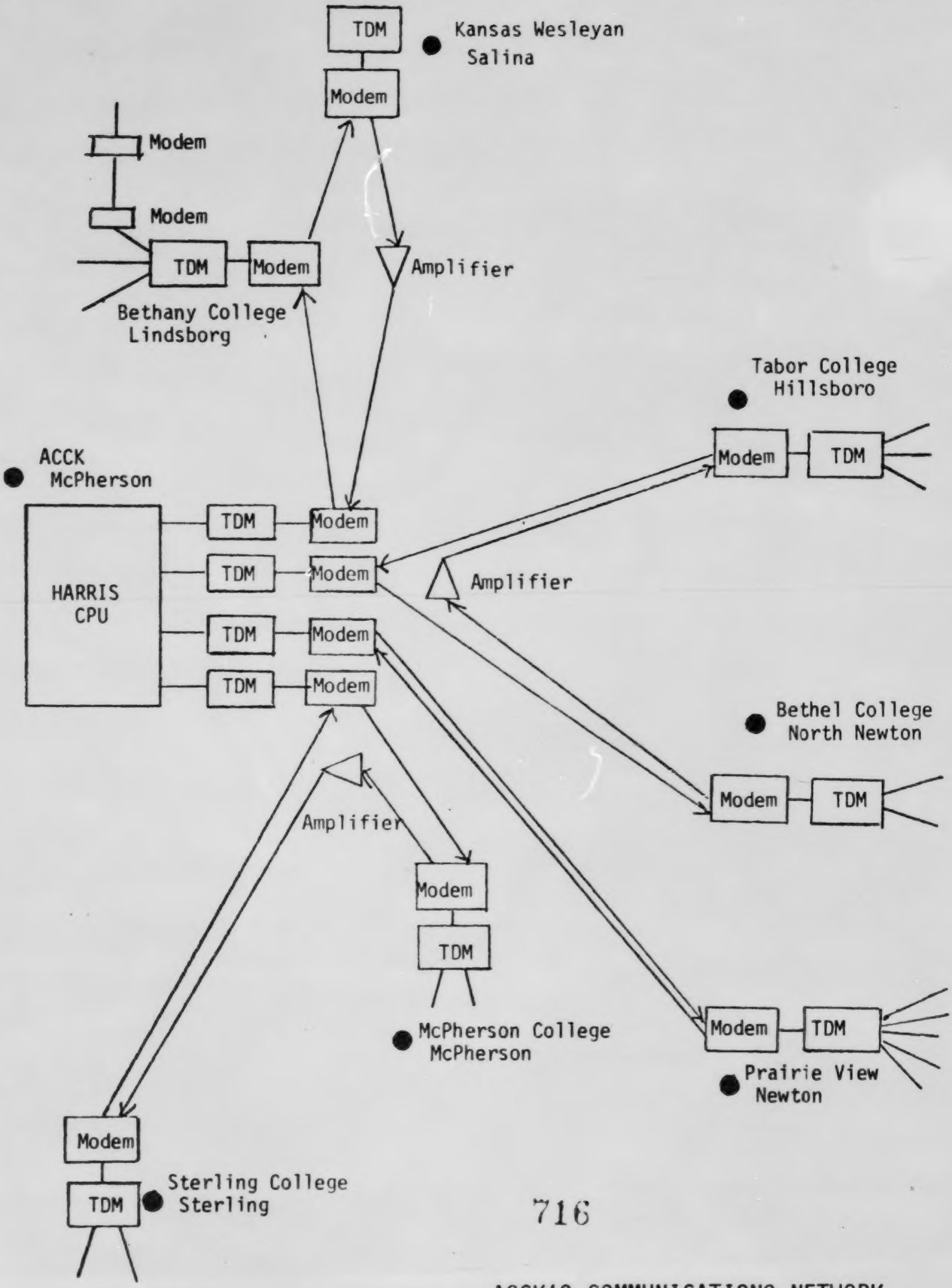
The cooperative operation of a computer center has served the six ACCK colleges well for the past twelve years. Developments in technology and in the colleges themselves imply that the success in the past will not automatically result in success in the future. The nature of sharing will change but with cooperative goodwill mutually benefical solutions to many of the problems of the future will be found in concert.

APPENDIX 1



HARRIS SYSTEM 210 COMPUTER CONFIGURATION
Associated Colleges of Central Kansas

APPENDIX 2



ACCK'S COMMUNICATIONS NETWORK
1978

SOFTWARE SERVICES AVAILABLE ON ACCK SYSTEM

A. VULCAN OPERATING SYSTEM

1. Multitasking, concurrent realtime, interative and batch support.
2. Virtual
3. Programs are fully re-entrant.
4. Access to devices and services controlled at the user number level.
5. Full system accounting for each session.
6. User core space is limited to 196 K bytes of instructions with up to 762 K bytes of data and instructions combined.
7. Real time programs may be connected to software or hardware triggerable interrupts or placed on a timer schedule.

B. JOBCNTRL

1. Performs general system tasks as directed by the user including file generation, elimination calling programs into execution, etc.
2. Programable; conditions can be tested, branches can occur.
3. Macros are files of jobcntrl commands that when executed are treated as new commands.

C. LANGUAGES

1. FORTRAN
   a. Conforms to the pending ANSI standard.
   b. Utilizes the floating point hardware.
2. COBOL
   a. Conforms to the 1974 ANSI standard at high level in all modules except communications.
   b. Compiles at about 1000 statements/ minutes elapsed time.

Software Services - continued

3. BASIC

   a. Conforms to the proposed ANSI standard with extension.
   b. Two implementations. The incremental version produces no object code but provides full trace and breakpoint support. Instructions are compiled as they are entered. The compiler version produces object code which must be link-edited to execute. Programs executed this way run about five times faster than incremental version of the same program.

4. SNOBOL

5. ASSEMBLER

6. PASCAL

D. SPECIALIZED SOFTWARE

1. TOTAL data base manager
2. SPSS (Level H)
3. PLOT-10 graphics support
4. NDTRAN simulation language
5. FAMULUS personal documentation system
6. RUNOFF document processing
7. DOC online documentation
8. HELP command documentation
9. QED Bell labs quick editor
10. VBUG interactive symbolic debugger

E. PUBLIC PROGRAM LIBRARY

Includes about 100 programs utilized mostly for instruction.

DOING MORE WITH LESS AND ENJOYING IT

GEORGE DIXON
BABSON COLLEGE
BABSON PARK
MASSACHUSETTS

ABSTRACT

Babson College is a small (2,000 F.T.E. students) management college located in the suburbs of Boston, Massachusetts. In 1969, the Babson based ACCOMP Consortium was founded to provide time-shared, mini-computer service to a variety of schools and colleges in the Boston area. In 1976, this consortium was expanded to provide time-shared administrative services as well as academic services. So Babson College began to "bootstrap" itself into an integrated student record processing system. That is, it started with nothing but a design concept, a philosophy and a manual paper process. Then using these and the "WISE" file management techniques from Digital Equipment, we have evolved and implemented an integrated on-line information system for student processing. This design process is reviewed. The affect on the organization using it will be discussed using case examples.

This is a narrative description of Babson College's experiences and successes in administrative systems development. It is hoped that the mini-computer based methodology will be of interest and that the problems as well as successes will prove instructional and beneficial. It will not be asserted that this system is in anyway unique or "best" for anyone except Babson. It is felt that it has been a successful and "good" way to go and may, therefore, provide a good object lesson to others.

INTRODUCTION

The purpose of this talk is to acquaint you with administrative data processing at Babson College using the Digital "WISE" series of programs. But before we get into the main subject, we would like to present just a brief message from our sponsors.

Babson College is a small management school located in the suburbs of Boston. It provides high quality, rigorous management education to 1,250 undergraduates. In addition, the Graduate Program offers the M.B.A. curriculum to some 300 full-time and 1,100 part-time (mostly evening) students. We have a stated goal of seeking excellence instead of diversity. That is providing high quality management education.

This is, I believe, more than just a plug for Babson. In particular, it is synopsized from the Babson Master Plan, a document which was first written in 1968 and reassessed in 1975. Under the current regime, master planning is a continuing effort which reexamines and revises this document annually. Consequently, you will find that some of the concepts which are portrayed in the synopsis of the College's goals are reflected in the structure of how we do things.

HISTORY

In the beginning, there was no computer at all. But as the school grew and the technology became more in evidence, it became clear that something had to be done. So, Babson College hired a Director of Academic Computing, Ned Canty, and told him to do something!! Since the year was 1968 and time sharing was in, Ned rented some teletypes and some time sharing time and began to do things. Two things became evident from this operation. First, this operation was expensive, and second, the service was not too good and it certainly was not tailored toward the beginning user. So Ned decided to survey some of the other small schools in the Boston area to see what they were doing. He found that in general, they were doing nothing or were dissatisfied with the facilities available.

Out of this situation the ACCOMP Consortium was born. Initially, it was no more than a dedication to explore the marketplace for better solutions. But in early 1970, it became operational with the purchase of an HP 2000 system to provide cheap time sharing for student use at member schools. Although the schools change somewhat from year to year, its basic mission remains today.

ACCOMP has also developed several philosophies which are of importance to its operation and continuance. For example, budgeting and payment for services is normally done on a fiscal year basis and is generally done in "port years." That is, at current prices, $3,200 will allow the connection of a terminal to the computer for an entire year. If you want to use it fine. If you don't use it, that's your problem. Another example is that each school must be responsible for its own affairs. A coordinator is appointed who is responsible for items such as bills, coordinating equipment availability, handling internal politics, and keeping students from calling the consortium directly. It is recognized that this is a sharing arrangement so that everyone is expected to help by deleting old files, etc. In addition, there is a monthly meeting of coordinators to discuss mutual problems and future plans.

What has evolved is a very serviceable and cheap computing environment which provides all of the required facilities with very few extras. It is expected and assumed each school will have its own needs and problems which it can and should solve for itself, and that mutual problems can be resolved so the system can provide optimal joint service.

Since its inception, there had been the belief that ACCOMP could also provide administrative computing services. However, in spite of a large number of meetings and seminars prior to 1976, this never became a reality. There were probably three major reasons for this. First, there are already a large number of available (mostly batch) facilities in the Boston area which provide reasonably adequate service. Second, there is a non-involvement syndrome which says that administrators want to get the work done and are not particularly interested in the "processing details," whereas professors are always attempting to evolve neat, new processing facilities and are typically quite involved with the details. Finally, there are some basic political issues: Faculty distrust of potential "administrative hogs," administrative wariness about potential "student security hazards," and basic skepticism and resistance to change on the part of many administrators. Specifically, the meetings almost always resulted in statements like: "That's fine, but I don't think we're interested right now." or "Show me that it can work and then I'll consider it."

Basically, I'm here to tell you that it can work and that sharing can provide benefits to both academics and administration. But it requires commitment and effort, lots of dedicated effort by the whole college community. Further, I would be a fool if I did not acknowledge that some of the fears about security and power plays have substance. The concerns are real and must be monitored, but like many of the other problems surrounding computer usage, they can be detected and resolved.

THE INCEPTION OF ADMINISTRATIVE COMPUTING

So where are we in this continuing saga of computer implementation at Babson? The year is 1975, ACCOMP is alive and running well. But the HP system is fully configured and fully sold so they are considering a second computer.

There is a basic distrust of administration on an academic machine, but no real prohibition against such use. Babson has already provided one port and some very successful rudimentary facilities to its Undergraduate Admissions Office. Further, the consortium is also considering a slightly fancier, multi-lingual mini-computer as its next step. The net result after a semester of study was the proposal that the consortium buy a Digital PDP-11/70 and that this machine should provide advanced academic services to students and administrative services to brave souls such as yours truly and a dedicated group at Suffolk University working in the Registrar's Office there. While this is not exactly a bold new departure, it did involve a commitment to a new facility as well as a revision to some of the underlying procedures. For example, administrative users require relatively large amounts of permanent disc storage so that disc usage is now monitored and billed separately. Also, some programs and facilities are predominantly "academic" or "administrative" so we have on a couple of occasions privately purchased some software. But "the experiment" has been successful and the difficulties have been minimal.

WISE AND THE GRADUATE PROGRAM

With the advent of the Digital computer in August of 1976, we embarked on the first real information system development at Babson. Out initial trial in the Undergraduate Admissions Office had convinced us that time sharing terminals could be used for this purpose and that generalized file maintenance and retrieval tools could be particularly effective. So, even though the WISE package did not offer all of the registration features that we wanted, we were convinced that the underlying concepts were correct.

The first major hurdle to system implementation was the prodigious amount of typing initially required to enter all of the data into the system. For, in the past, the great majority of Babson's administrative processing had been handled with the typewriter and pen. We did not have the luxury of a first or second generation system which provided data or a "fall back" position. In order to realize some of our bright prospects, we had to face some of the cruel realities of the world. First, we could not stop the current operation of the school to "get going." Second, the old forms were inappropriate for keypunching. Third, the student data was somewhat sensitive so that access should be limited to those who normally handled it. Consequently, we were forced to use registration clerks for data entry and to hire students and other outside help to perform other functions in the Registrar's Office.

In any case, one would have to describe these times as hectic and tense for all of us. My programmer was exceedingly busy training clerical personnel and writing programs to assist them as well as making the many adaptions required to do the job properly. So we spent the year entering data and writing programs, but we were making progress and everyone kept a reasonably positive attitude. Even Debbie, who spent almost six months continuously on the terminals, was known to smile occasionally, when the computer was down for maintenance. By the end of the first term we entered and published grades on the computer. After a hectic Christmas break, we did registration changes on line in January and provided accurate class lists for the first time. By July 1977, we were publishing full transcripts and degree audits for all 1,500 graduate students. During the September registration, things finally seemed to start calming down somewhat. There was still some trauma since this was the first cycle that applicants were automatically transferred from the admissions file to the student file without programmer assistance. The real test came when my programmer left us in October and I had to continue the operation myself for two months before we replaced him. You see, this entire operation was accomplished by our one and only programmer with some part-time assistance from me.

WHAT IS WISE?

Since I am not a Digital salesman, I do not want to sell you WISE, BASIC PLUS or PDP hardware. But I would like to take a moment to tell you about WISE features and limitations since it provides some good technical background.

First and foremost, WISE is an extremely effective and easy-to-use programming tool. It provides within its "skeleton" functions all of the necessary facilities to easily manipulate or report on data in its file system. This is the one thing which allowed us to accomplish so much in the first man-year of programming time.

As long as I have introduced the concept of file system (as opposed to database) let me digress for a moment into some technical details. WISE works with a group of files whose characteristics are looked up in a central directory called "RECORD.WIS". Each file is made up of records and each record contains named data items. WISE provides facilities which retrieve data by name. It also provides facilities to link files together and to get records directly by record number or indexed in alphabetic, ID, or zip code order. So WISE actually provides many database facilities while retaining a multiplicity of sometimes redundant files. I can go into more detail if you are interested, but I think this gives you a general flavor.

Second, and also extremely useful, are the "UPDATE" and "REQUEST" programs. These provide facilities to add, delete or change records in any file and to provide simple reports or address labels. While these are reasonably straightforward programs with only moderate complexity, it turns out that their generality allows them to cover 80-85% of the admissions function, about 40-50% of the Registrar's function and about 50% of the alumni function. These are very heavily used programs. I will assert that our clerical people all know and understand this part of WISE. Unfortunately, their thoughts and comments are not always as complimentary as mine, but they use them extensively anyway.

Third, WISE has some useful functional programs for registering students, posting grades, copying applicants' data from the admissions file to the student file and student information from the student file to the alumni file.

Finally, WISE has a fully operational sample file system and a set of reporting programs which handle most of the problems of student data processing. While this feature may be relatively unimportant to an ongoing data processing effort, it is my perception that most small schools like Babson are just getting into data processing. In this case, the prototypical system provides three incredibly useful features:

1.) It is something to use until you can perfect or design something better.

2.) It is something for administrators with no computing background to play on and complain about so that you can indeed decide what tools are needed and what would be better. -- Everyone is a natural born critic!!

3.) It has prototypical file and program structures for programmers that are new to PDP-11's, RSTS, and BASIC PLUS. I find it is always easier to copy a "good" programming style until I become thoroughly familiar with all of the facilities, features, foibles, etc. Indeed many small schools are making use of newly graduated programmers and/or student programmers who need this help to get started.

WISE also has some rather distinct limitations which should be brought to light. The first limitation is program size. The RSTS operating system runs fixed partitions of 64K bytes. The BASIC PLUS interpreter requires

32K bytes so this leaves only 32K bytes in active program use. Those very effective skeleton functions which are so neat are also pretty big and tend to have quite a few file buffers open. So one has to envision several small programs instead of one gigantic one. This problem can be very irksome at times.

The second limitation of major importance is a 32,767 record per file limitation which limits the use of WISE to schools of 5,000 students or less (5,000 x 5 courses/student = 25,000) and makes items like full transcript processing problematical for enrollments above 2,000.

Fortunately, as I stated in the introduction, Babson runs two distinct programs (Graduate and Undergraduate) of about 1,400 students each so that we have been able to live within this framework.

The final limitation is that Digital Organization apparently has a limited commitment to the expansion or enhancement of the WISE programs. I must hasten to add that this comment does not imply any lack of maintenance or support for the currently available programs, but concerns additional functions and functional areas such as billing, general ledger and financial aid. Unfortunately, this limitation has some of the same frustrating psychology that is beginning to emerge in the second phase of the Graduate Office to be discussed next. It revolves around a discussion which goes something like: "If you can do all this so well, why can't you do more?" "Because I'm busy working with others who need help." I know that, but I need help too!" In my case, the lack of financial programs is still, in my view, a fairly serious limitation.

THE SECOND PHASE - EXPANSION, INTEGRATION AND TRAINING

Back to our story. With the departure of our only programmer came a review of where we were and at what pace we could hope to accomplish things.

In particular, there was a strong desire to "get something done in accounting, especially student billing." So along with replacement of our programmer we would hire a second programmer and I would be assigned full-time. Administrative data processing had come of age and become a regular activity.

With the turnover and reorganization of the M.I.S. Office, we began to experience our first changes in clerical personnel. This made it abundantly clear that our user documentation was not just weak but totally inadequate. We had included time for initial training of clerical personnel but we certainly had not allocated time for training each new employee hired. It would obviously be impossible to expand our operation very far if this were necessary! What was wrong? Well, our hectic pace had not allowed us much time to train supervisory people in the Graduate Office. So we started a two pronged effort to develop documentation and to insure that supervisory personnel had sufficient understanding of the system and its operation to assist new clerks where necessary.

Explaining "grundgy details" to the Dean also allowed us to introduce a reorganization and restructuring of the file system. This effort was our first really thorough review of the data since our first conceptual design. As you might predict, there was quite a bit of weeding and cleaning necessary and quite a few new items of interest. At the same time, we began to integrate the data which would be needed for the "ARCHON BILLS" student billing system which we had purchased from the QUODATA COMPANY in Hartford. This package already had a "WISE" interface which allowed it to extract name and address information, etc. from the student file so it inherently provided the required integration that we desired between the ongoing graduate operation and the expansion into the accounting area.

We finally have a fully operational graduate system which not only covers student data, but also produces bills and accounts for tuition, fees, etc. I must note that this last addition has created a bit of trauma of its own. Indeed the Associate Dean remarked last week that my warning did not prepare him for all of the problems that the Accounting Office uncovered. In his words, "Continually having the Accountants watching my mistakes is getting to me. They are very thorough!" As is, I think, typical in most small schools, we at Babson had never rigorously cross-checked every detail between offices. So if one student's registration record was fouled up or his address was wrong in the Registrar's Office, it was not necessarily reflected in his bill. We had allowed ourselves the luxury of duplication and decoupled processing. With our new system design we are trying to "tighten up the ship." Needless to say, this is sometimes quite painful but we are beginning to experience some distinct benefits in terms of cash flow and data clean-up.

The expansion of the M.I.S. functions is rapidly producing inroads into other areas of the school as well. We have already converted the Undergraduate Admissions Office over to the "WISE" system and have spent two and a half months planning an undergraduate student system which we hope to have in initial operation within four months. And in our spare time we have provided interim name and address processing facilities for the Alumni Office. This is considered an interim facility since we have not yet tackled the problems of gift recording and the many other data items that will eventually be needed. However, like the Graduate Office, the Alumni Office is finding the data entry task to be time-consuming so they are currently in the process of carefully reassessing their needs.

SUMMARY AND COMMENTS

This has purposely been a somewhat long and rambling description of the implementation of administrative programs at Babson. It has been my hope that this mechanism would provide some insights into both how and why we attacked problems in certain ways. While I would not begin to assert that our solution would work at another school without careful scrutiny, assessment and revision, I do believe that small schools have similar problems and needs. I perceive that Babson and I are somewhat pioneering in the use of mini-computers and time sharing to solve these problems so perhaps our experience will help those that follow.

Before I conclude, there are several specific areas which I want to cover briefly.

The first is a sales concept which says mini or micro computers, especially of the stand-alone variety, can be purchased with applications software and be run by trained clerical personnel with no assistance. Baloney!! You need technically trained and qualified people in the environment!! Would you expect someone with three weeks of driver education to operate a dump truck 200 miles from the nearest garage or mechanic? Someday the equipment may become fantastically reliable or everyone may know how to "drive" it, but we've got a long way to go.

The second is a new user concept which says that the software designer knows what he is doing so he will tell me what I need and how I should use it. While this attitude is great for a systems analyst's ego, it is almost always fatal when the user finds out that it doesn't work right. What is absolutely essential is a team effort consisting of users, programmers, and supervisors working together to provide the best possible facilities. In particular, I was quite surprised at the amount of effort QUODATA expended "tailoring" their bills package when it was already in use at another school with very similar hardware and software.

Finally, most small schools are starting from nothing, without a trained staff of computer analysts or programmers. It is completely unreasonable for them to expect their operation to change overnight. Yet when you talk to administrators from these colleges, you find that they attend conferences and go home all fired up, saying "Babson is doing it -- My place can too!!" Yes, you can. But it is hard work!! Babson has been working at it for two years and we've got at least three more to go!! So, if you are a small college administrator, get fired up and go home and start planning a five or more year effort. It is a big job and you must continue the current operation while you get started. Also, you probably cannot afford $500-600 thousand to hire an outside agency to do the job for you! But the time to start planning is now.

In conclusion, I would like to thank you for your attention to the "Babson Story", and I would like to reiterate that small school on-line data processing has finally become a reality. That it is hard work which requires commitment by everyone involved. But the results are rewarding because you can see the progress and because you can accomplish previously unattainable goals. I'm certainly enjoying it.

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CAMEO

Comprehensive Automated Management of Educational Organizations

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INTRODUCTION

The CAMEO system was implemented at Middlesex County College, (MCC), in Edison, New Jersey during the Fall-1978 term. MCC is the largest of New Jersey's county colleges; serving over eleven thousand day and evening students, plus a substantial Community Services Division offering primarily non-credit courses. The Community Services Division is not currently on the CAMEO system; their conversion is planned in 1979.

Under the new leadership of Doctor Rose Channing, the first woman president of a New Jersey county college, MCC is planning the development of a complete MIS upon the resources of CAMEO. The currently implemented system components are primarily student oriented. The overview following this section includes a list of the primary areas currently addressed.

Following the system overview, a few pages of text explain some CAMEO concepts and capabilities. Then several pages present illustrations of CAMEO functions via annotated copies of actual CRT formats, which were produced on printing terminals attached to the CRT's.

OVERVIEW

CAMEO, (Comphrensive Automated Management of Educational Organizations), is a composite of integrated computer application systems. College functions supported by the system include:

Student Academic Records
Student Personal Records
Counseling and Student Program Planning
Tuition and Fee Billing
Management Statistical Analysis
Curriculum Scheduling
Facilities Records and Management
Recruiting
Admissions
Testing
Grading
Registration
Financial Aid
Staff Assignments

The system is completely on-line, and interfaced to the user offices via a network of CRT terminals. The terminals employed, (IBM 3270 compatible), provide the capability to present the data to the users in predefined formats. The formats consist of protected ("display-only" data and headings), and unprotected (data the user may modify or enter), fields; so the users make modification or addition by employing simple "fill-in-the-blank" logic.

Many advanced concepts and extensive capabilities are contained in this comprehensive and expandable system. Yet a very high degree of efficiency is maintained; so that operation on the smaller models of the IBM 360/370 series computers is feasible. Examples of concepts and capabilites include:

* Centralized Database (a very extensive, modualr database; developed with substantial consideration given the NCHEMS data elements).

* Table-driven edit logic (a generalized data table system is included).

- A comprehensive multi-level password security system (allows complete control of data access and modification).

- Complete backup and recovery capability; and a complete audit trail of system activity.

- Extensive data integrity provisions and operational support provisions.

- Extensive support software (all database I/O, and several utilities).

- An advanced telecommunications monitor system, and an extensive source program library system are included.

CONCEPTS AND CAPABILITIES

To a complete practical degree, the CAMEO system is both on-line and real-time. Transactions are processed immediately and completely upon input; not stored for subsequent batch processing. CAMEO is a transaction oriented system; and each transaction is discrete.

CAMEO utilizes the CATER monitor system. Since they were developed by the same source, there are several complimentary capabilities and CAMEO takes full advantage of several CATER features. But they are independent. While it would not be a negligible task, (as such never are), CAMEO could be converted to another monitor system.

There are a number of philosophies which strongly influenced most aspects of CAMEO development. In no particular order, they include:

1. Efficiency is a substantial virtue. It's true that CPU power and storage are increasingly less expensive; but it is not agreed that processing and storage efficiency are not important concerns to most installations.

2. Conventional independent file structures do not meet current requirements. A centralized database is a basic requirement of an effective modern MIS. But many formal DBMS offerings entail prohibitive costs and/or inefficiencies.

3. The data processing function must automate itself. We must perceive the requirement to make effective use of our software development/maintenance resource; as well as other center resources.

4. A related need is to consider the areas of modification, maintenance, and trouble-shooting in our software development engineering. The system will probably not well serve the user if we cannot be responsive when required.

5. Extensive data integrity and security provisions are necessary. But to be most efficient they should be transparent, (and therefore unavoidable), to applications programs to the greatest practical degree.

6. Computer applications must be integrated to be completely effective. And since all applications will not be developed in concert, and most will frequently change; this integration capability must be a dynamic attribute of each application.

Some of these statements bear expansion. As was mentioned, the data processing function cannot afford to be a "barefoot cobbler". Anything can be carried to extreme, but we cannot most effectively serve our organization unless we well equip ourselves. Obvious specific examples include program library systems and other utilities. But it shouldn't stop there. Another important area is documentation. It should be automated to the greatest degree practical. Further, it is most desirable if it is unavoidable to use, and even productive to use. An example, from CAMEO, is the way we handle record descriptions. The data element dictionary utility provides a programmer oriented listing, (or CRT format), which supplants the conventional record layout. In many organizations, records may be and are frequently modified without corresponding updating of record layouts in the documentation. In CAMEO we don't change the records; we change the data element dictionary, and it automatically generates the record description. So, in this optimum example, we updated the documentation, and it updated the system.

Several other benefits are entailed in automated documentation. Using the data element utility example again, it contrbutes a great deal to effective communications among those involved with the system. The same utility whcih produced the programmer oriented listings, also provides user oriented listings. And since it generates the record description code itself, including the COBOL names of data elements, data terminology becomes completely consistant. Further benefits of this same example include automatic generation of much of the mundane coding in on-line programs. We have a program which, from a small parameter deck, generates a significant percentage of a normal on-line program, up to several hundred statements. This is a boon to programmer productivity (as well as to data entry and operations).

CAMEO enbodies a centralized database which was designed to utilize the best qualities of both discrete file structures and DBMS concepts. No manufacturer's access software is utilized. Externally the database is one or more direct files. Internally, they are divided into flexible logical subfiles. The monitor provides spaces management, and all actual I/O (at the physical level), and several important data integrity and security functions. All are generic services; the monitor doesn't know file and record structures. This is vested in the I/O logic modules, which fall between the monitor and the application programs.

The subfiles themselves can vary as required. They include all types of organization, such as direct; indexed; sequential; and chained. The complete database is available to any program as required. The complete database and attendent logic modules is managed as an entity.

Normally, each subfile contains related records. Record structure is normally fixed but modular. We shouldn't build "walls" which limit data structures to "6 of these" and "eleven of those". We must be able to handle the record of a student who has attended any number of terms, and students who may have enrolled in any number of courses.

Database integrity is a primary concern. This is reflected in several features. Included is extensive editing of all input. Improper input is not accepted. Most initial editing is table driven. And, since the system is real-time, contextual editing is also performed. Of course effective backup and recovery procedures and capabilities are essential provisions for database integrity. CAMEO contians both. The monitor writes all file-maintenance transactions to a separate recovery file upon entry into the system. And the complete database is backed up to tape each day. If necessary, the database can be restored to a given time, and then recovery records reprocessed, (with selectivity if required).

Another significant database integrity provision in CAMEO is the "backup block" feature. This feature is transparent to applications programmers. Simply, it ensures that, unless every step of any transaction and related programs is successfully completed, no change to the database will occur. The "incomplete transaction" cannot occur in CAMEO. And users always receive a positive edit response.

This paper can't address CAMEO concepts and features exhaustively, but one additional very important basic concept bears discussion. It affects and serves several system functions, including: file maintenance; audit trail; transactions between applications; batch interface and backup; and others.

The CAMEO log record concept is based upon the strict use of "log" records to reflect all system activity. Log records are defined to reflect every data element in the system. The general format of log records is consistant. Each contains data identifying the source and time of the transaction, and each contains up to just over a hundred bytes of data fields. On-line program structure standards cause data to be first edited, then placed in the log record data fields which serves as the basis for file updates. Obviously, this first provides for the accuracy of the audit trail, to which all processed log records are written.

Inter-program transaction processing is also facilitated by this logic. Since all programs perform file updates from edited log records, the programs may send transactions so formatted to any other program for processing. This is a very powerful feature. Every system function is by original design open to communication with any other application component. The monitor provides the transaction-queue service which controls and administrates this feature. Interfacing this facility to a batch subsystem will provide a single avenue of batch access to all online functions for backup and auxillary operations.

EDITOR'S NOTE: Forty-seven pages of the CAMEO CRT Format illustrations supporting this paper are available from the CAUSE National Office at the cost of reproduction.

COMPUTER COOPERATIVE FOR A MULTI-CAMPUS SYSTEM

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New Orleans, Louisiana

SOFTWARE COOPERATIVE FOR A MULTI-CAMPUS SYSTEM

I. INTRODUCTION

This paper describes a software cooperative for a multi-campus system--the Massachusetts Board of Regional Community Colleges (MBRCC). Established in 1959 by enactment of the Legislature of the Commonwealth of Massachusetts, MBRCC now consists of fifteen colleges, located throughout the Commonwealth, which share many of the management problems, and opportunities, facing other multi-campus systems (and individually-governed institutions). The fifteen colleges represent a diverse set of institutions. The issues of stable management practices and equitable computing capacities, has been of major policy concern since 1971. The colleges have experienced a period of declining financial base; a concern of the erosion of their managerial autonomy by the governing board; the introduction of unionization of the faculty and classified staff; and an ever increasing expectation to provide greater services to their service communities with less resources.

The above described environment is not unique to the Massachusetts community colleges. In fact, this environment is shared by many other colleges and universities throughout the United States and other industrialized countries. as discussed at the recent OECD Conference in Paris which explored the issues of managing the University in the 1980s (LeVasseur). While the environment is not unique, the solution adopted and being implemented by MBRCC and its member colleges is unique. The solution is a software cooperative predicated upon a common hardware vendor and a consulting firm to provide technical assistance to develop the required administrative software. Below we review the reasons why the software cooperative was formed; the approach being utilized in implementing the software cooperative; and the potential of other colleges participating and benefiting frcm the direction being taken by the Massachusetts Community Colleges. Appendices present the technical and organizational concepts being used to develop the first major application -- student records and a summary of priority needs.

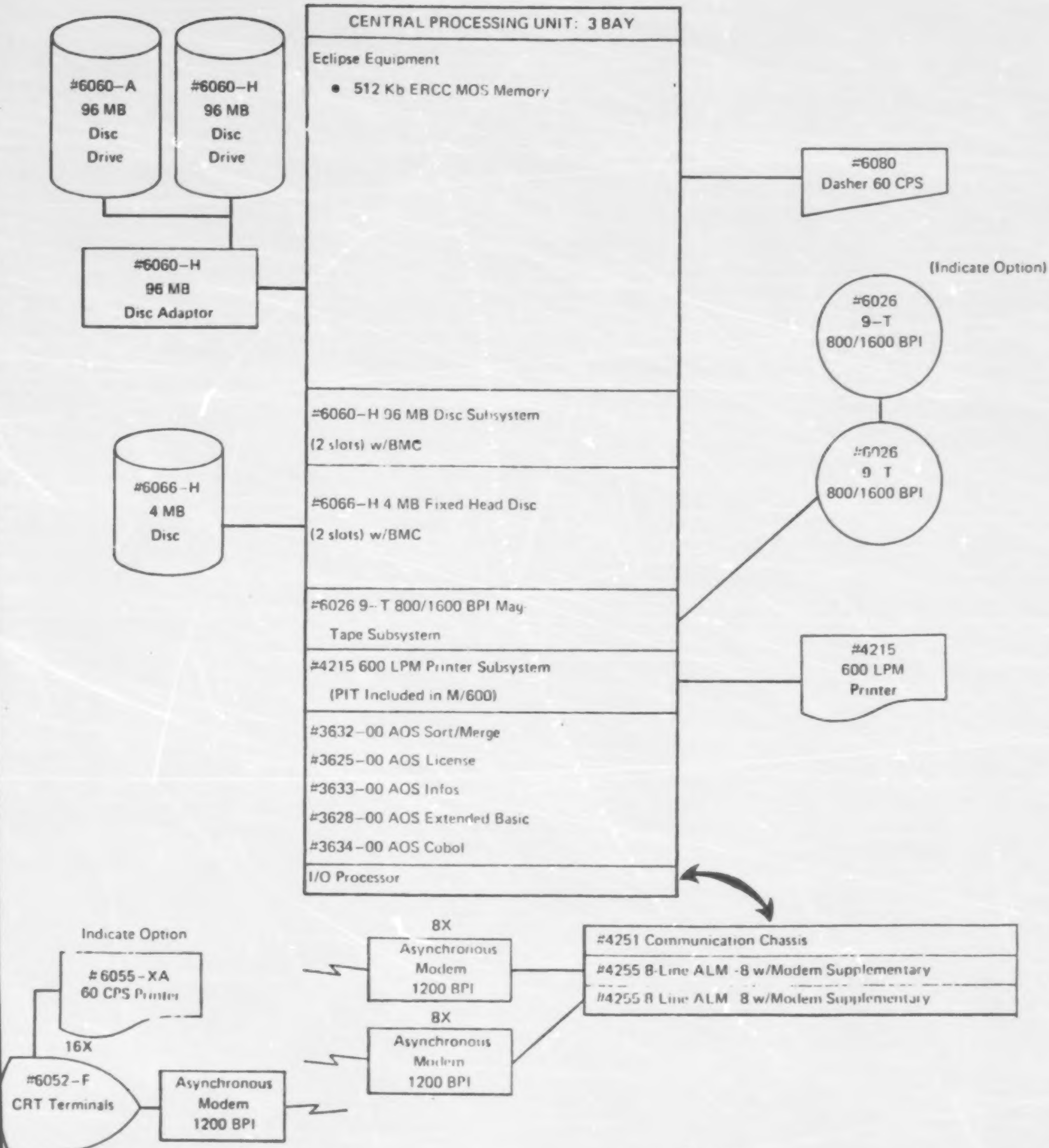
II. REASONS FOR FORMING THE SOFTWARE COOPERATIVE

The Massachusetts Board of Regional Community Colleges has made every effort to develop and implement an efficient and cost effective computer capacity for all fifteen colleges in the system. The planning and equipment procurement process began in 1971 and has been under constant re-evaluation since.

In 1971 and 1972 the Community College System formulated a statewide plan for the development of data processing for the Community Colleges. A systemwide committee recommended that the Community Colleges not go the way of the Massachusetts State Colleges in developing a "star-computing" network (Demb). It suggested instead that each of the Community Colleges should have an independent computing capability as well as a capability to communicate among themselves and perhaps with the regional computer center. Recent technological developments of minicomputers now make implementation of this strategy feasible. This type of alternative is a distributive computing network which permits processing both locally and conducting telecommunications with the Board Office in Boston (Greenough).

Since 1974/75 the Community Colleges have let three Requests for Porposals from computer equipment manufacturers. Bids from the first two RFP's were not accepted pending further study. In 1976, before a third bid was released, the Board contracted with Mr. James Farmer of System Research to study the computing needs of the Community Colleges (Farmer). This study served as a basis for a third Request for Proposals in 1977 which resulted in the award of a systemwide contract for the Eclipse line of minicomputers to the Data General Corporation of Westboro, Massachusetts. This award allows for either purchase or lease at a preferential educational discount rate. The anticipated base configuration is presented in Figure 1.

MASSACHUSETTS BOARD OF REGIONAL COMMUNITY COLLEGES
BASE COMPUTER CONFIGURATION
DATA GENERAL ECLIPSE SERIES EQUIPMENT



One of the fifteen Community Colleges, North Shore Community College, was awarded an Advanced Institutional Development Program grant from the U. S. Office of Education in 1976. This grant permitted NSCC to have the staff of Arthur D. Little, Inc., serve as an assisting agency for the development of a Planning, Management, and Evaluation (PME) System, with the supporting information system infrastructure.

As a part of this grant activity, a report was developed by Arthur D. Little, Inc., in cooperation with the Institutional Development Task Force of North Shore Community College, in which recommendations were made which had as their keynote the formation of a Software Cooperative. This report highlighted: (1) the lack of administrative software on DG equipment; (2) the availability of academic software; and (3) the desirability of executing academic and administrative computing on the same equipment (Clements and Rodgers). The results of this report were shared with all the other MBRCC Presidents and selected staff at an Invitational Conference on October 14, 1977. Subsequently, at a President's Council Meeting on December 15, 1977, the Presidents voted to proceed with the Software Cooperative. A Change of Specifications was executed to the Arthur D. Little contract to serve as the assisting agency for all fifteen Massachusetts Community Colleges.

The following objectives have been adopted for the MBRCC Software Cooperative:

1. Information Standards - Develop information and data standards for MBRCC system as a whole, including -
    - definition of information requirements coming from sources external to MBRCC Institutions (e.g., Bureau of Labor Statistics for manpower data); and
    - definition of information requirements for institutional and system-wide planning and management purposes.

2. Interim Software Packages - Facilitate the sharing of interim software packages which have been developed by colleges within and outside the Massachusetts Community College System;

3. Software Development - Supervise the design and implementation of software applications for sharing among the colleges using the Data General Eclipse line equipment with the following priorities as established in a survey of almost seven hundred representatives of all fifteen colleges, the Board, and its staff:

   - Admissions and student records;
   - Financial aid administration;
   - Financial management applications;
   - Planning, management, and institutional research;
   - Library applications;
   - Physical plant operations;
   - Other administrative applications;
   - General administrative service applications; and
   - Auxiliary service applications.

   These definitions were adapted from the survey by Hamblen, and the approximately 130 modules comprising the above nine areas are presented in Table 1. This software is being developed under contract by Arthur D. Little Systems, Inc., of Burlington Massachusetts.

4. Academic Computing - Function as a catalyst for improving the academic use of the computer and as a clearinghouse for academic computing software.

5. Hardware Procurement - Establish a standard for equitable computing capacity for each campus; provide technical assistance for reviewing the requirements for detailed hardware,

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TABLE 1
INSTITUTIONAL ADMINISTRATIVE APPLICATIONS .
SOFTWARE COOPERATIVE: TOTAL INFORMATION SYSTEM

ADMISSIONS AND RECORDS APPLICATIONS

- Undergraduate Admissions Processing
- Graduate Admissions Processing
- High School Testing Records
- Course Master Records (Catalog)
- Schedule of Classes Preparation
- Student Class Scheduling
- Tuition & Fee Assessment
- Student Registration Processing
- Class Rosters
- Term Student Records & Reports
- Course Add/Drop Processing
- Enrollment Reporting
- Enrollment Statistics
- Student Ethnic Group Reporting
- Term Grade Reporting
- Honors Program Records
- Student Transcript Master Records
- Degree Requirements Evaluation
- Correspondence Course Records

FINANCIAL AID ADMINISTRATION

- Financial Aid Evaluation
- Financial Awards
- Student Employment Records
- Work Study Records

FINANCIAL MANAGEMENT APPLICATIONS

- General Fund Ledger
- General Fund Expenditure Accounting
- Departmental Expenditure Accounting
- General Accounts Receivable
- Student Accounts Receivable
- Accounts Payable
- Payroll
- Employee Benefit Accounting
- Retirement System Accounting
- Bank Account Reconciliation
- Cash Flow Projection
- Investment Records
- Investment Evaluation
- Grant & Contract Administration
- Research Project Accounting
- Research Proposal Monitoring
- Financial Aid Accounting
- Tuition & Fee Accounting
- Residence Hall Accounting
- Stores Accounting
- Telephone Accounting

PHYSICAL PLANT OPERATIONS

- Physical Plant Accounting
- Physical Plant Job Scheduling
- Building Maintenance Costs
- Equipment Preventative Maintenance
- Key Inventory

PLANNING, MANAGEMENT & INSTITUTIONAL RESEARCH

- Budget Forecasting
- Budget Preparation
- Budget Analysis
- Budget Position Control
- Institutional Cost Studies
- Faculty Salary Analysis
- Support Staff Salary Analysis
- Faculty Activity Analysis
- Support Staff Activity Analysis
- Induced Staff Activity Analysis
- Resource Requirements Modeling
- Student Flow Modeling
- Long Range Planning
- Enrollment Forecasting
- HEGIS Reporting
- Data Element Dictionary
- Institutional Coding Structures

GENERAL ADMINISTRATIVE SERVICE APPLICATIONS

- Facilities Inventory (Space)
- Facilities Utilization Analysis
- Classroom Utilization Analysis
- Personnel Records
- Personnel Evaluation
- Personnel Placement
- HEW Compliance Reporting
- Staff Ethnic Group Reporting
- Civil Service Position Records

LIBRARY APPLICATIONS

- Acquisitions
- Cataloging
- Card & Material Preparation & Control
- Circulation Control
- Serials Holdings
- Bibliographical Search Service
- Fugitive (Ephemeral) Material Indexing
- Educational Media Services

LOGISTICS AND RELATED SERVICES

- Purchase Order Follow Up
- Purchasing Information System
- Vendor Information System
- Stores Inventory
- Office Machine Repair Control
- Equipment Inventory
- Automobile Registration
- Parking Lot Space Assignment
- Traffic Violation Records
- Crime Reporting
- Car Pool Matching
- Motor Pool Records

AUXILIARY SERVICE APPLICATIONS

- Faculty/Staff Directory
- Faculty Club Billing
- Residence Hall Assignment
- Student Directory Preparation
- Student Housing Reports
- Food Service Menu Planning & Inventory
- Bookstore Inventory & Operations

OTHER ADMINISTRATIVE APPLICATIONS

- Alumni Records
- Foundation & Gift Records
- Test Scoring & Analysis
- Curriculum Planning
- Teacher Evaluation
- Teacher Placement
- Fraternity/Sorority Rush Records
- Student Counseling Records
- Student Psychological Testing
- Athletic Event Ticket System

NOTE These components are subject to modification and expansion based upon the findings of future cooperative activities.

software, and personnel needs to ensure efficient use of the computer capacity of the Community College System.

The Software Cooperative has been established as a "voluntary network" (Schon) within the established governance structure of MBRCC. The Presidents Council, representing all fifteen colleges, is responsible for all policy decisions of the software cooperative. Dr. George Traicoff, President of North Shore Communicty College, chairs the Software Cooperative. Mr. Michael H. Hanna has been appointed Director of Computers for MBRCC and is responsible for all day-to-day matters of the software cooperative.

III SYSTEM DESIGN APPROACH TO AGREE TO THE DEFINITION OF THE STUDENT RECORDS SYSTEM

Experience in the field of education and other fields has demonstrated that the approach to system design and development has as much to do with the ultimate use of the computing solution (including software and hardware) as the technical validity of the solution. For instance, the software product may well perform the technical tasks for which it was designed, but these tasks may not be the ones that the ultimate users desired or anticipated. (Demb; Schultz and Slevin; Grogan and Rodgers; and Rodgers and Rhodes). We have explicited designed a system design process for the software cooperative which incorporates the previous failures and deficiences so that past mistakes will not be replicated. Many of these problems have been associated with "turnkey" software. Of course, it is possible that we will make new mistakes. This approach includes four phases:

- Phase I Develop a strategic information system plan;
- Phase II Systems Design -- Determine how the system is to perform, from both a general design, functional specification; and test the technical concepts to be employed;
- Phase III System development and implementation at North Shore Community College; and
- Phase IV Product installation at each site, including standard and non-standard implementation.

The total project is estimated to take three to five years.

All activities of Phases I and II (both General Design and Functional Specifications) of the MBRCC Software Cooperative Systems Development

Process contribute to agreement on the functional specifications of the student records systems. The steps are summarized in Table 2, which indicates the two phases; the objectives of each phase; the process of user input; the Arthur D. Little Systems response to user input; and the products developed in each phase.

Phase I - Develop Strategic Information System Plan - is to define the commonality and diversity of user needs between and among the fifteen community colleges of the Massachusetts Community College System and the Board office. This objective is achieved through the use of a group administered, pre-coded survey in which 667 of the potential users of the information system had an opportunity to participate in the priority establishment and assessment activities related to the design and implementation of more effective computing capabilities in the community college system. The results of this survey identified the educational computing needs for MBRCC over the next ten years. (Arthur D. Little System and Opinion Research Corporation). This survey combined with other analyses, were used to establish a Ten Year Automation Plan identifying: 1) Academic Computing Needs; 2) Administrative Computing Needs; and 3) Equitable Hardware Requirements.

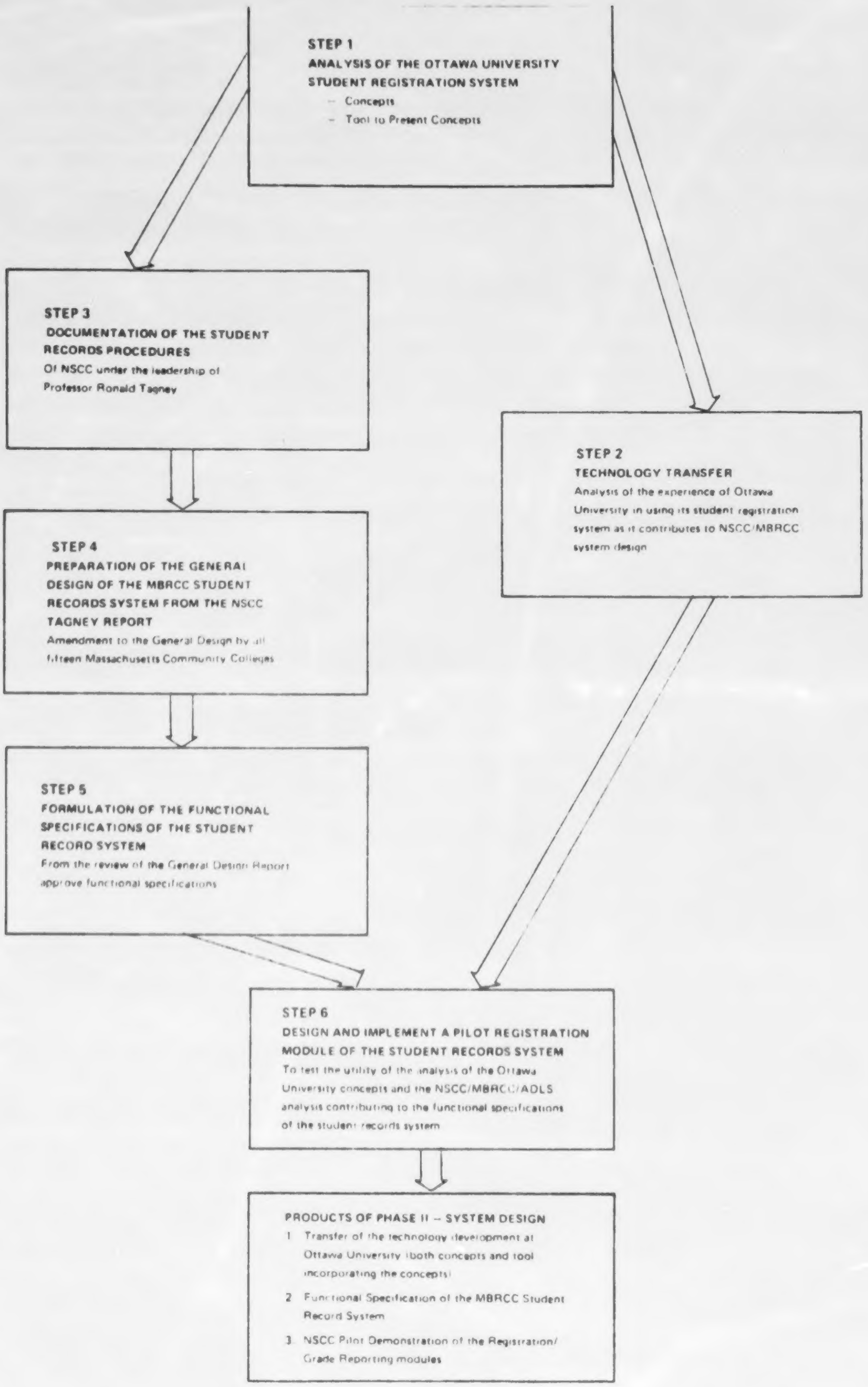
Phase II has three parts - General Design; Functional Specifications and testing system concepts. Phase II - General Design - formulates the general design of the student record system. These steps are summarized in Figure 3. The objectives of this step are to document the administrative procedures of North Shore Community College, as an example of the administrative procedures used by other Massachusetts community colleges. Next, these procedures were analyzed to determine effective data processing support with respect to information input, processing, and reporting requirements. Finally, the databases necessary to accomplish the functions of the administrative procedures are used to define the database for the student records system.

TABLE 1---STEPS TO AGREE ON FUNCTIONAL SPECIFICATIONS OF STUDENT RECORDS SYSTEM
MBRCC SOFTWARE COOPERATIVE

PHASE	OBJECTIVE	PROCESS OF USER INPUT	ADLS RESPONSE TO USER INPUT	PRODUCTS
PHASE I – Develop Strategic Information System Plan	Define commonality and diversity of user needs. – 15 Community Colleges –MBRCC Office	– Group administered precoded survey – Review results of survey at each campus	Translate user needs into: – Conceptual design – System philosophy – Priorities	Report of survey results Strategic Information System Plan

PHASE II – Formulate General Design	– Document administrative procedures of North Shore Community College
	– Conduct task analyses of administrative procedures to determine effective data processing support with respect to:
	  – Information input
	  – Processing
	  – Reporting requirements
	– Define data base
		– Document all administrative procedures at NSCC
		– Develop general design for NSCC
		– Review NSCC general design with all other colleges to determine changes to meet their needs
			– Develop general design from review of NSCC procedures
			– Modify general design based upon review by all other Massachusetts Community Colleges
				General Design of Student Record System
				with Amendments

PHASE II – Define Functional Specifications	To agree to the following: – System transactions and work flow narratives; – Data base definition (including taxonomies and coding structures); – Screen and report layouts; – An illustrated description of the interactive process for each transaction detailing what the user does and what, in functional terms, the computer does, – System control & audit features – Backup and recovery procedures; and – User startup and shutdown procedures.	Each college to review functional specifications and make amendments.	Initial functional specifications based on general design and amendments. Approved functional specifications incorporating approved amendments.	Initial Functional Specifications Approved Functional Specifications
PHASE II – Test Concepts of the Proposed Student Records System	Test concepts of the student records system – Database – On-line, real time environment – Functional Applications – High-Level Reporting Language – Transaction-based processing	Actually test a pilot system during a real registration cycle Evaluate results of the test	Assist the staff of one college utilize a pilot system during a registration cycle Evaluate results of the test Incorporate the results of the test in the software development	Pilot demonstration of the system concepts in the form of a tool which potential users can test and evaluate



STEP 1
ANALYSIS OF THE OTTAWA UNIVERSITY STUDENT REGISTRATION SYSTEM
- Concepts
- Tool to Present Concepts

STEP 2
TECHNOLOGY TRANSFER
Analysis of the experience of Ottawa University in using its student registration system as it contributes to NSCC/MBRCC system design

STEP 3
DOCUMENTATION OF THE STUDENT RECORDS PROCEDURES
Of NSCC under the leadership of Professor Ronald Tagney

STEP 4
PREPARATION OF THE GENERAL DESIGN OF THE MBRCC STUDENT RECORDS SYSTEM FROM THE NSCC TAGNEY REPORT
Amendment to the General Design by all fifteen Massachusetts Community Colleges

STEP 5
FORMULATION OF THE FUNCTIONAL SPECIFICATIONS OF THE STUDENT RECORD SYSTEM
From the review of the General Design Report approve functional specifications

STEP 6
DESIGN AND IMPLEMENT A PILOT REGISTRATION MODULE OF THE STUDENT RECORDS SYSTEM
To test the utility of the analysis of the Ottawa University concepts and the NSCC/MBRCC/ADLS analysis contributing to the functional specifications of the student records system

PRODUCTS OF PHASE II – SYSTEM DESIGN
1. Transfer of the technology development at Ottawa University (both concepts and tool incorporating the concepts)
2. Functional Specification of the MBRCC Student Record System
3. NSCC Pilot Demonstration of the Registration/Grade Reporting modules

FIGURE 2
MASSACHUSETTS BOARD OF REGIONAL COMMUNITY COLLEGES
SOFTWARE COOPERATIVE
PHASE II – APPROACH TO SYSTEM DESIGN

The process at NSCC included a review of the administrative procedures of the college with active participation by all the members of the offices involved in student records processing. The documentation and administrative procedures at North Shore were conducted by Professor Ronald Tagney utilizing a work plan formulated by Kenneth W. Rodgers of Arthur D. Little Systems and assisted by Ms. Sherry Gordon of Arthur D. Little. (Tagney.)

If we were designing the student records system for NSCC only, then we could stop here. However, all the other colleges must review the NSCC procedures to determine how the procedures at their colleges differ. The report of Professor Tagney's work was utilized as input into the formulation of the General Design Report (Martin and Rodgers). Based upon the review of the General Design Report by other Massachusetts Community colleges, we will modify the general design based upon amendments which are approved by the MBRCC Software Cooperative. The product of this phase is the general design of the student record systems with approved amendments.

The next step to agree on the functional specifications is Phase II - Define Functional Specifications. The objectives of this step are to agree to the following:

- System transaction and work flow narratives;
- Data base definition including taxonomies and coding structures;
- Screens and report layouts;
- An illustrated description of the interactive processing for each transaction detailing what the user does and what, in functional terms, the computer does;

- Systems control and audit features;
- Backup and recovery procedures; and
- User start-up and shut-down procedures.

The functional specifications of the student records system describes the anticipated system to meet the general design requirements requested by all fifteen of the Massachusetts community colleges. In addition, the student records requirements recently determined for a four-year, liberal arts college are included (Clements and Gordon). This task is underway, and will be completed in January, 1979.

The final step of Phase II is testing the concepts to be included in the student records system. This testing, being conducted as part of the system design process, permits demonstrating the efficacy of the suggested approach before the actual development of the intended system. A system developed at Ottawa University in Kansas was used as a "base system." This system has been analyzed, modified, and adapted to meet the needs of North Shore Community College.

This "new" system will be tested at North Shore Community College during the January, 1979, registration. Based upon the results of the January registration, and the agreements to the functional specifications, the student records system will be developed during Phase III. Phase IV activities will be devoted to adaption, installation, documentation, and training in the use of the system at other colleges in the Massachusetts community system which voluntarily elected to utilize the software.

The above steps were elected to permit the fifteen colleges of the Software Cooperative to agree upon functional specifications for the student records system. The steps have been designed to provide adequate opportunity for communications between and among the various potential users of the student records system and the Arthur D. Little Systems staff who are responsible for the design and implementation of the system to meet the identified user needs. The steps have been organized to provide a logical, sequential, and inter-dependent process for developing the student records system. The steps begin with the general, or strategic, level and proceed to the very specific and operational level. Three different review processes are included. Through this collaborative approach, we will be able to collectively determine functional specifications of the student record system which will meet user needs.

IV FACTORS EFFECTING IMPLEMENTATION OF THE SOFTWARE COOPERATIVE

Implementation of the software cooperative has not been without frustration, concerns, and anxieties by those who are responsible for being served by the system. Recall that approximately 700 persons participated in the Phase I survey and approximately 200 persons in Phase II. In total, fifteen colleges are participating in the system design process.

Permit us to summarize several factors and characteristics which have affected the implementation of the software cooperative;

- Participation - given the scope of the student records system and the fifteen colleges to use the software approximately 700 people have been involved in priority establishment and diagnostic processes;

- Procedures for Agreement - many policy and technical issues have to be highlighted and resolved in order for the intended system to meet user expectations;

- Minicomputer Technology - minicomputers offer substantial cost savings if the issues of adequate administrative software can be resolved. The software cooperative affords a vehicle for resolving these issues cost effectively and efficiently.

- Best Accepted Practice - the conceptual design of the software solution has benefitted from the experience of other colleges and universities. Sharing experiences contributes to improving the software design. The sharing has occurred for both the administrative procedures and the existing software approaches.

- Resource Sharing - no college can afford the approximately $2 million for software development. The cooperative affords an opportunity to share this cost and to benefit from using current state-of-the-art technology for improving the management of colleges and universities.

- Problem Recognition - many colleges have not recognized the need to consider a software coooperative because the administration has not recognized the magnitude of the costs for developing administrative software. The cooperative has assisted its members in understanding the magnitude of the problem and offers a cost-effective and proven solution.

- Understanding Computer Technology - the policy decisions of the cooperative are made by the Presidents and other administrators with adequate briefings by their data processing staff. All issues are explained in a manner which is comprehensible to the layman. Where necessary, technical issues are explicated in sufficient detail to permit thorough technical review.

- Remonstrated Performance and Efficacy of Concepts - the multi-year system design process has been broken down into segments so that working products are available within eight months from beginning the cooperative. These working systems assist potential members to evaluate the descriptions of the tool and an actual working component of the system. It is not necessary to wait two to three years before a system is developed.

- Complement Existing Capabilities of Cooperative Members and The Technical Assistance Agency - the cooperative is a "teaming agreement" between cooperative members and Arthur D. Little Systems, Inc. This "teaming agreement" permits matching the capabilities of cooperative members and ADLS staff for a cost-effective and dependable solution.

The above characteristics and factors distinguishes the system development process of the software cooperative from other approaches.

V SOFTWARE COOPERATIVE

The software cooperative presents an approach to the design and implementation of a cost-effective minicomputer based information system to meet the identified information system needs for colleges and universities. The software cooperative provides adequate computing capabilities for the next five to ten years. During this time many demanding requirements will be placed upon the member colleges to continue to respond to the diverse educational needs of students in a period of rising expectations and declining resourses.

We concur with the assesment of many colleges and universities to develop a comprehensive management information system. Such solutions are a very ambitious undertaking. Many other colleges have plans quite similar to the information system plan developed by the Massachusetts Board of Regional Community Colleges .

The staff of North Shore believe that no college can afford the software development costs of a complete information system. In fact, the current economics of minicomputers until just recently permit small colleges to afford the computer resources necessary to support such information systems. Arthur D. Little Systems, Inc. expects to develop a full range of administrative applications over the next five years.

How can other colleges and universities benefit from joining the software cooperative? First, you will receive the student record system, being developed at North Shore Community College, (and subsequent applications as available), without having to pay for the development costs. Then, through institutional or third-party resources, support:

- the design and development of an additional application; and
- the procurement of the computer resources necessary to support the anticipated information system.

These two steps would take approximately two to three years, and would result in the nucleus of a mature management information system. Table 3 summarizes what joining the software cooperative would mean, including current and proposed members of the software cooperative, their contributions, products, and their availability dates. By joining the software cooperative and contributing software, other colleges and universities would be eligible to install all future software applications developed by Arthur D. Little Systems. Through this approach, you would then have a better ability to achieve your goals of a comprehensive information system over the next five years, without an undue drain of the limited institutional resources.

In summary, the software cooperative now makes it feasible for other colleges and universities to achieve desired goals of designing and implementing a comprehensive management information system by:

- procuring a minicomputer necessary to support the mature management information system;
- receiving the benefit of the development of the student record system at North Shore Community College without having to pay the development costs;
- supporting the development of an additional application appropriate for your purposes;
- gaining access to future administrative applications to be developed by Arthur D. Little Systems, Inc. as supported by other cooperative members.

We believe that the total development costs for the complete product line of administrative applications to be between $1 and $2 million. A single or group of colleges costs for this product line would only be for the minicomputer, the development of an application; and the installation fee for other applications. Therefore, your goals of developing and implementing a management information system can be

TABLE 3
ATLANTA UNIVERSITY CENTER
PROPOSED APPROACH TO SYSTEMS DEVELOPMENT
SOFTWARE COOPERATIVE

COOPERATIVE MEMBER	CONTRIBUTION	PRODUCT	AVAILABILITY DATES	COSTS
Ottawa University Ottawa, Kansas (AIDP Institution)	Development of "nucleus" student record software (admissions; registration and grade reporting; alumni)	Software to be used: – as "nucleus" software – demonstration tool	July, 1978	$ 200,000
Massachusetts Board of Regional Community Colleges Boston, Massachusetts (includes two AIDP institutions: North Shore Community College and Quinsigamond Community College)	Design and implementation of student records system including: – data base design – functional applications – tool to access data base	Software product for installation at MBRCC installations; and other cooperative members	July, 1979	$ 285,000
	Design and implementation of financial records system: – data base design – functional applications – tool to access data base	Software product for installation at one site for all six institutions; and other cooperative members	18 months from date of authorization	$ 170,000
Additional Cooperative Members	Support for design and implementation activities	● Physical Plant Operations ● Planning, Management and Institutional Research ● General Administrative Service Operations ● Library Applications ● Logistics and Related Services ● Auxiliary Service Applications ● Other Administrative Applications	As Authorized	Approximately $1,000,000 – 1,500,000

achieved in a cost effective and timely manner. If you have any questions about the potential of your institution joining the cooperative, please feel free to contact Dr. George Traicoff or Mr. Kenneth W. Rodgers for further details.

EDITOR'S NOTE: Appendix A and B supporting this document are available from the CAUSE National Office at the cost of reproduction.

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DATA AS AN INSTITUTIONAL RESOURCE IN A PLANNING, MANAGEMENT AND EVALUATION SYSTEM

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Critical as institutional planning is to a college's survival, only a small number "have effectively developed a plan, based on sound data about themselves and their setting, which is revised at least annually and upon which the institution's leadership acts daily." (L. Richard Meeth, Quality Education for Less Money) Planning is a primary administrative function antecedent to managing and evaluating. A Planning, Managing, and Evaluating (PME) system is firmly based on an organizational process which strives to gather facts and put them together to produce meaning. These facts are linked to the mission and essential purposes of the institution and can be agregated under categories such as (1) admissions, (2) financial aid, (3) attrition and retention, (4) institutional programs costs, (5) library, (6) faculty productivity and reward structure, (7) personnel benefits, (8) new program development, (9) student learning outcomes, (10) budgeting and fund raising.

Data are the foundation upon which to build the multi-year institution Plan, a document containing a grand design representing intelligent anticipation of activites, events, and experimental observations carefully specified in advance to more from one point to another. Data are needed (1) about environmental assumptions upon which to base planning; (2) about potential clients and unmet societal needs growing out of a needs assessment or market analysis/market segmentation process; and (3) for managing institutional areas as specified above. Probably most important, however, the data analysis process must strive to produce meaning as it relates to efficiency and effectiveness of relating dollars to institutional goals and objectives.

Shortly after I began to work on my presentation, Bob and I were reminded of the minister who had been reassigned to a parish in Texas. Because he wanted to impress the congregation, he pulled his best sermon from his files. Only one parishioner, a cowboy, appeared in church on Sunday. The minister preached the entire sermon. After church the minister asked the cowboy how he liked the sermon. The cowboy responded, "You know Reverend, each night I take a load of fodder down to the watering hole to feed the cattle. If only one cow shows up, however, I don't give her the whole load."

After spending some time on the presentation and not wanting to give you the entire load, we arrived on the following limited, but achieveable objectives:

1. To define planning as used in this paper and list the elements of a comprehensive institutional planning process.
2. To describe the budgeting process and a method for relating fiscal resources to institutional goals and objectives.
3. To discuss the relationship between data and its use in a planning, management, and evaluation (PME) system.

THE NEED FOR PLANNING

The future of any institution including higher education, rests on the degree to which it meets the needs of the society in which it exists. As society changes, so must higher education change. If higher education is to remain a viable institution, it must be responsive to the needs of society. The way in which a specific college meets the challenge of being responsive to societal needs is a function, for the most part, of its sophistication in planning: comprehensive, long-range and systematic. As critical as institutional planning is to a college's survival, however, only a very small number "have effectively developed a plan, based on sound data about themselves and their setting, which is revised at least annually and upon which the institution's leadership acts daily."[1] The Ohio Citizen's Task Force on Higher Education[2] and the Ohio Board of Regents Master Plan[3] identify paramount goals for Ohio's diverse structure of higher education and call for a shift from episodic, periodic production of master plans once every five years to a continuous systemic mode of planning.

PLANNING DEFINED

What is planning? The word planning is inadequate for expressing the wide range of encompassing concepts. The word does not differentiate between merely taking some thought of the immediate consequences of a single, simple act or accounting for all the variables throughout the ten-year period of landing a man on the moon and returning him safely to earth. In curriculum planning the word is the same whether we mean (1) specifying a single criterion-referenced objective for a student to demonstrate or (2) the arraying of the thousands of objectives necessary to demonstrate competence in order to earn a degree or (3) accounting for all the variables throughout a multi-year period of developing and field testing a new strategy for the preparation of professionals as in competency-based teacher education.

Some planning is a characteristic and pervasive behavior of all human beings and organizations; it is the hallmark of what we call rationality. If we were to draw a line to represent the possible range of ways an organization might make its decisions, one end of it could be called Ad Hoc and the other end Planned. In the Ad Hoc mode, decisions are made one-by-one according to the mood and judgment of the decision makers(s), unrestrained by plan or even precedents. In the Planned mode, every decision is wholly constrained by a previously adopted plan. There are, in practice, few examples of these perfect extremes. Somewhere between these two extremes is where most organizations are in their planning.

ELEMENTS OF THE PLANNING PROCESS

Planning is primary administrative function antecedent to implementing, coordinating and evaluating. A comprehensive planning process has several elements. First, there is a planning protocol. Some person(s) at an institution have responsibility for planning various aspects of the institution and they will follow some procedure in doing whatever it is they will do. How they do whatever they do should follow an agreed-upon set of steps.

Second, there is the need to develop a planning structure. Most institutions have some sort of structure for coordinating the ongoing activities of the institution. The structure may be quite simple, with a minimum number of persons participating in the decision-making process, or it may be quite complex involving a number of review committees and several levels of review boards. Regardless of complexity, there must be some structure for planning.

Third, there must be some way for stating and achieving consensus by appropriate groups on environmental assumptions about the institutions. Environmental assumptions are both *internal* and *external* to the institution. Internal environmental assumptions cut across every aspect of the institution, including program, students, instructional program costs, and fund raising. External environmental assumptions include such things as societal needs, economy, legislative mandates and state support. These assumptions are important in developing the alternative scenarios most likely to emerge in the next five to 10 years.

Environmental assumptions are an integral part of the planning process, particularly for technical education. Technical education prepares persons for "middle manpower" positions, a segment of the manpower spectrum which lies between the recognized professions on the one hand and the manual trades and crafts on the other.[4] The term subsumes a number of types of persons such as paraprofessional, semiprofessional, subprofessional, technician, foreman, middle management, engineering aide, and even some highly skilled crafts and trades. Educationally, the middle manpower occupations require education and training beyond high school but not to the level of the baccalaureate degree.

There are numerous sources of environmental assumptions. Statements about the general direction of higher education include (1) a shift from quantity revolution to an equality revolution,[5] (2) a switch from "educational opportunity for all to "educational opportunity for each",[6] (3) a spectacular increase of older students,[7] and (4) an effort to link more closely the world of work and the world of education.[8] Environmental assumptions relate to career education, continuing education, life long learning,[9] and systems for measuring educational accomplishments. In the recent address by Robert E. Kinsinger, Vice President of the W. K. Kellogg Foundation, several interesting changes were forecast.[10]

1. Postsecondary education will modify even further its former preoccupation with the educational needs of youth and increase dramatically its responsibility for providing lifelong educational opportunities.
2. The procedure for measuring educational accomplishments will change in dramatic ways. The system of amassing largely time-related academic units to reach the required total for a degree will yield to different output measures related to levels of competency in reference to designated bodies of knowledge and sets of skills.

Technological advancements are recorded in numerous sources and are essential in keeping the curriculum content current.[11]

A method for specifying goals is also integral to planning. This includes a methodology for (1) generating goal statements; (2) sorting, categorizing and prioritizing these goals; (3) refining the goals into specific objectives and noting interrelationships among them; and (4) specifying the relevance of goals and objectives to the support base of personal, physical and fiscal resources. Goals and objectives can be intramural or intermural.

Environmental assumptions are a source of goals and objectives. Goals can be obtained from needs assessment or market analysis.[12] Market analysis consists of obtaining detailed information about markets or market segments served or unserved by the institution. Market analysis is an organized effort to identify the relationship between specific needs and the ways the institution meets or could meet them. Market analysis is, in its simplest description, a more coherent way to plan our responses to environmental conditions. Another source of goals and objectives is a critical analysis or diagnosis of the students presently served by the college and its current curriculum offerings.

When goals have been stated and prioritized, a program is developed for each goal labeled a high priority. This stage of the planning process should yield a plan of action for each high priority goal. The plan of action should include specific objectives stated in the form of intended outcomes, a sequence of activities and events to lead from one point to another, and a time-line for reaching the goal. There should also be some plan for monitoring progress and evaluating the outcomes of the process of reaching the goal as well as the impact of the goal.

Sixth, there should be some formal evaluation protocol for examining the comprehensive planning process. The planning process yields a Plan, a document containing a grand design representing intelligent anticipation of activities, events, and experimental observations carefully specified in advance to move from one point to another. Evaluation of the planning process can be accomplished by persons within the organization or by some group external to it. (A Comprehensive Planning Process is Displayed in FIGURE 1)

Planning, however defined, has a focus on designing and shaping the future as opposed to merely changing. Integral to planning are methodologies for (1) generating goal statements and standards; (2) sorting, categorizing and prioritizing goals; (3) refining goals, noting interrelationships among

FIGURE 1

A Comprehensive Planning Process

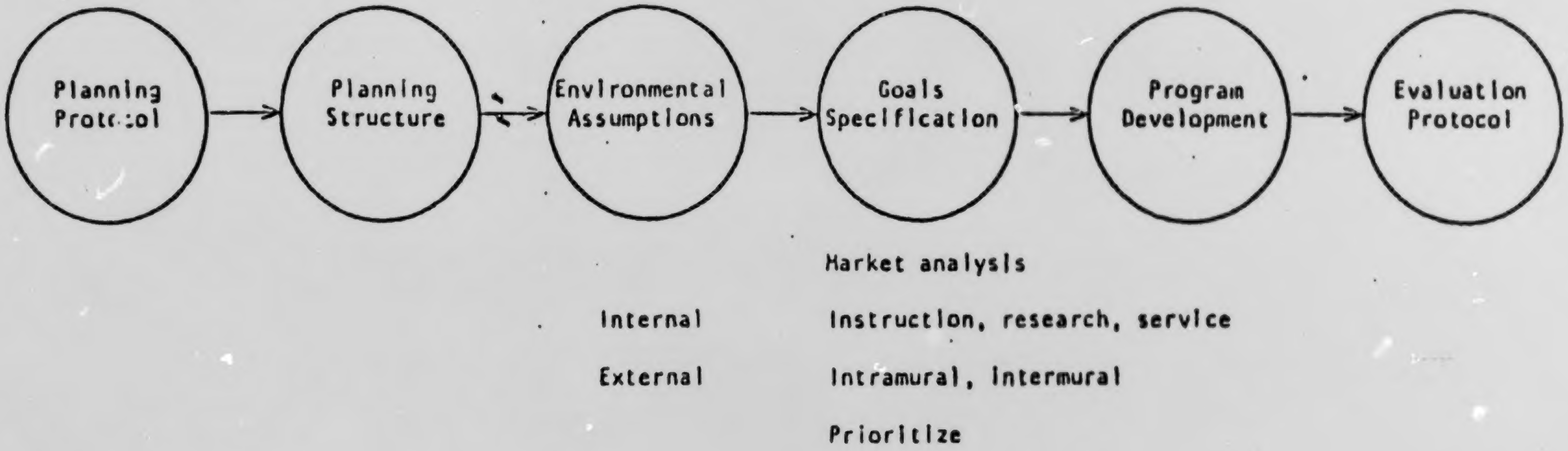
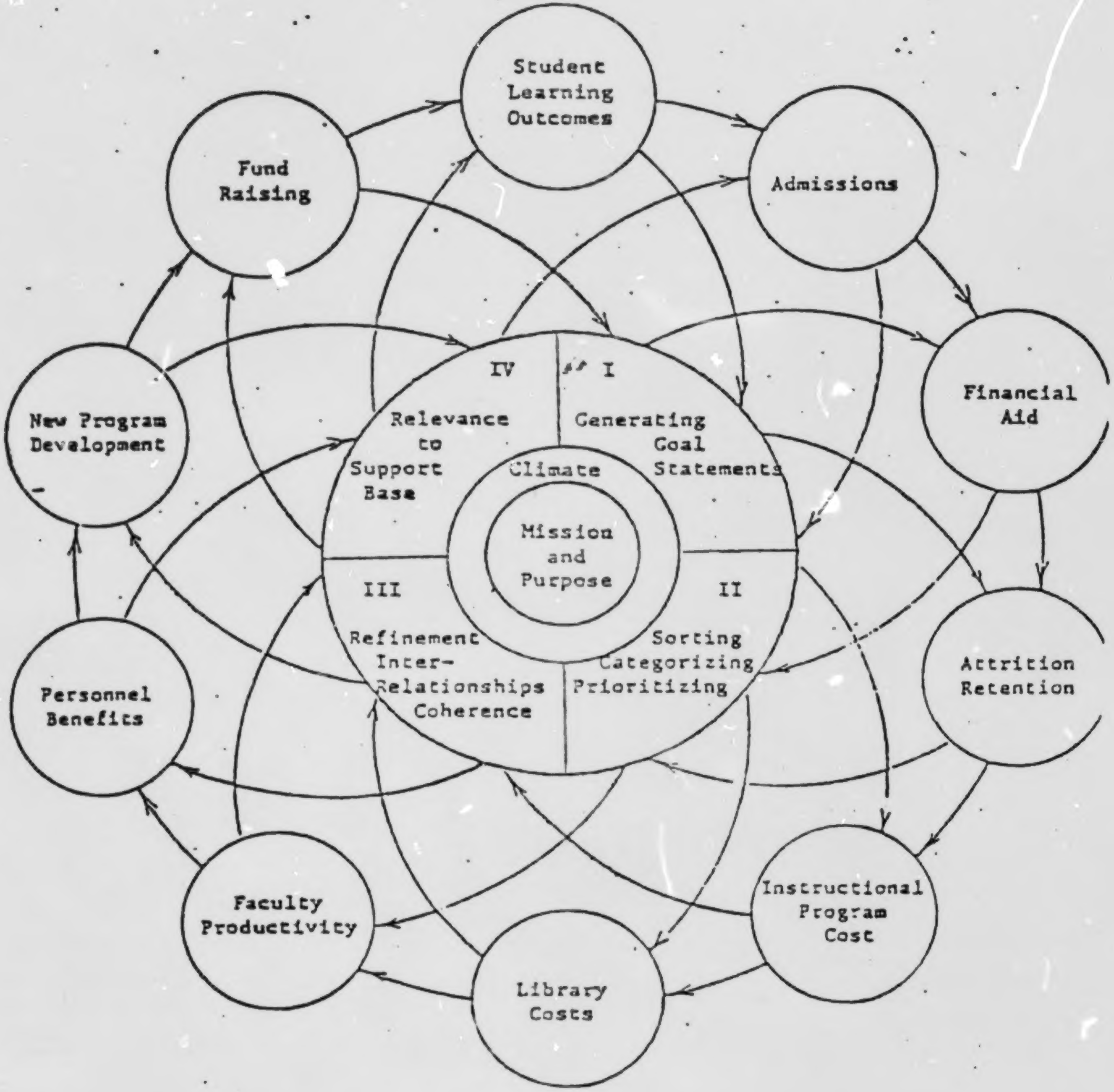


FIGURE 2

A Model of the Relationship of Institutional Data


Student Learning Outcomes
Admissions
Financial Aid
Attrition Retention
Instructional Program Cost
Library Costs
Faculty Productivity
Personnel Benefits
New Program Development
Fund Raising
IV
I
Relevance to Support Base
Generating Goal Statements
Climate
Mission and Purpose
III
II
Refinement Inter-Relationships Coherence
Sorting Categorizing Prioritizing

them; and (4) specifying the relevance of goals to the support base. As suggested in the preceeding paragraphs, organizations strive to gather facts and put them together to produce meaning. These facts can be aggregated under categories such as (1) admissions, (2) financial aid, (3) attrition and retention, (4) instructional program costs, (5) library costs, (6) faculty productivity, (7) personnel benefits, (8) new program development, (9) fund-raising, and (10) student learning outcomes. (FIGURE 2 is a model of the relationship of institutional data. The model does not imply that data packages are related only to other packages to which there is a connecting line. Rather, the design suggests that mission and purpose are the core for all institutional goals and that data modules are interrelated with each other and should be supportive of the institutional goals.) Planning, then, is critical analysis and requires the development of an analytical capability to collect, array, and analyze a large number of variables in an effort to portray a system of relationships, causality in some cases. The latter is the primary function of the Management Information System.

The planning process recognizes a distinction between "ends-oriented" planning and "means-oriented" planning.[13] Ends-oriented planning deals with specification of institutional mission and purpose and major policies relating to the social ends to which the institution shall be dedicated. This is the legal responsibility of the Board of Trustees in concert with the chief institutional executive. This level could be labeled Strategic Planning I. Depending upon size and organization of a particular institution, an Executive Council may be charged with the responsibility of specifying broad goal areas for institutional development in instruction, research and service. This level could be labeled Strategic Planning II.

Means-oriented planning refers to subsequent refinement of institutional goals into departmental objectives, program objectives, course objectives, and specific activities. Departmental level planning could be labeled Tactical Planning I, while planning in the hands of a small group of faculty could be labeled Tactical Planning II. This distinction is useful in that it suggests that trustees, administrators, faculty, and students all share responsibility for planning.

It is important to discuss in greater detail selected elements in the planning process. A clear statement of institutional mission and purpose is critical if the planning process is to have any meaning whatsoever. It is the "heart" of the insitution and provides general direction to all aspects of the planning process, institutional decision-making including policy formation, and to which all purposeful human activity can be linked. Because it is important that each participant within the college community understand the mission and purpose of the institution, in this case a technical college offering occupationally oriented programs, it is important to define a term such as "technology" and to review essential characteristics of occupational education programs. George Bugliarello, President of Polytechnic Institute of New York, suggests a biosocial view of technology:[14]

> Technology is a process, it is a social process which generates and combines know-how and people in order to extend the physical range of man. The range, if you like, and power over muscles, over the brain, and over organs. Thus, technology is a people process; it's done by people and it enhances people.
>
> But it is also a biological process, because in enhancing people, it continues to be carried on outside of our bodies. And by now, really, to a growing extent, with pacemakers and artificial organs, also inside our bodies. It continues to carry out the process of evolution. Both as a people process and as a biological process, technology has been with us from the very beginning of our species some two million years ago. Thus, technology was born with people, technology has been developed by people and technology has affected people.

Arnold Metz, President of the American Technical Education Association, provides some essential characteristics of occupational education programs:[15]

1. The program is directly related to employment opportunities.
2. The content of the courses which comprise the program is based upon periodic analysis of the occupations for which the training is being given.
3. The courses for specific occupation or related occupations (occupational clusters) are established and maintained with the advice and cooperation of the various occupational groups concerned.
4. The facilites and equipment used in instruction are comparable to those found in the particular occupation.
5. The conditions under which instruction is given duplicate as nearly as possible desirable, and in some cases undesirable, conditions in the occupation itself and at the same time, provide effective learning situations.
6. The length of the teaching periods and the total hours of instruction are determined by the requirements of the occupation and the needs of the students.
7. Training in a particular occupation or occupational area is carried to the point of developing marketable skills abilities, understandings work habits, and appreciations sufficient to enable the trainee to obtain and hold a job.
8. Classes are scheduled at hours and during sessions convenient to the enrollees.
9. Instruction is offered only to persons who want, need, and can profit from it occupationally.
10. The teachers are competent in the occupation for which they are giving instruction and possess adequate professional qualifications for teaching.
11. Vocational guidance, including effective follow-up of all students who finish or drop out of a course, is an integral and continuing part of the program.
12. Continuous research for course improvement is an integral part of the programs.

Because each institution is unique, it is impossible to list a definitive set of environmental assumptions and institutional goals and objectives which any other institution can automatically adopt from elsewhere. In specifying assumptions upon which to base planning, North Central Technical College found it useful to develop a list to stimulate thinking and to group the assumptions. The list of categories for stating assumptions is as follows:

1. Assumptions about the social context within which NCTC exists
2. Assumptions about external agencies
3. Assumptions about institutional leadership/management
4. Assumptions about NCTC programs (existing and potential)
5. Assumptions about potential clients and enrollment
6. Assumptions about student services
7. Assumptions about staffing and professional development
8. Assumptions about physical plant
9. Assumptions about equipment
10. Assumptions about fiscal resources

Planning assumptions about the social context in which an institution exists can focus on such issues of health, energy, transportation, lifelong training, quality of worklife, leisure, credentializing such as licensure and certification and program and institutional accreditation. Planning assumptions about external agencies can focus on the relationship between an institution and state and local governance, higher education as a system, articulation, and communication. Planning assumptions about existing and potential programs include new credit and non-credit programs growing out of needs analysis or market segmentation studies, use of advisory committees, and instructional development and support programs. Programs can be defined as new in content format, new in delivery system format such as cooperative programs, or new in evaluation format such as in competency-based education.

A project by the American Association of State Colleges and Universities uses societal trends and societal values as a way of planning futures and bringing planning assumptions into focus. The project uses a cross-influence matrix of 12 societal trends and 12 values to determine goals in 10 areas. The 12 societal trends are population, government, global affairs, environment, energy, economy, science and technology, human settlements, work, life style, women and participation. The 12 societal values are change, freedom, equality, leisure, interdependence, pluralism, localism, ethics, knowledge, quality, goals, and foresight. The 10 goal areas are finance, students, research and development, public service, facilities, faculty, curricula, administration, resources, and athletics.[16]

North Central Technical College also found it useful to develop a list of categories for setting goals and objectives (1) as a means for stimulating goals and objectives across a broad range of areas, (2) to provide a guide for similarity of goals and objectives for all departments within the college, and (3) as a framework for allocating dollars to goals and objectives across the college. FIGURE 3 is a list of Categories of Goals and Objectives and FIGURE 4 is a Model for Indexing Goals and Objectives. Data about the changing nature of the marketplace, including clients served and potential clients, and institutional management are sources of goals and objectives. In designing a planning process, consideration should be given to the functions of management and evaluation.[19] Management By Objectives (MBO)[20] and Program Evaluation and Review Technique (PERT) are tools which can assist an institution with these functions.

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FIGURE 3

CATEGORIES OF GOALS AND OBJECTIVES

01. CURRICULUM

    01.1 Content (single course, sequence of courses, a complete program)
    01.2 Method of delivering content (teaching and learning styles)
    01.3 Evaluating student acquisition of knowledge and skills (categories of cognitive, affective, and psychomotor development)
    01.4 Setting minimum competency standards
    01.5 Development of continuing education
    01.6 Conversion to metric system

02. PROFESSIONAL GROWTH

    02.1 Content in a discipline(s) or technology
    02.2 Teaching method
    02.3 Testing student achievement
    02.4 Stages of adult and career development
    02.5 Advising and counseling students

03. DEPARTMENTAL FUNCTIONS (Academic program, admissions, placement)

04. INTERNAL COMMUNICATIONS

05. EXTERNAL COMMUNICATIONS

06. OFFICE MANAGEMENT

07. MANAGEMENT INFORMATION SYSTEM

08. COMMUNITY SERVICE

09. OPERATIONAL AGREEMENTS

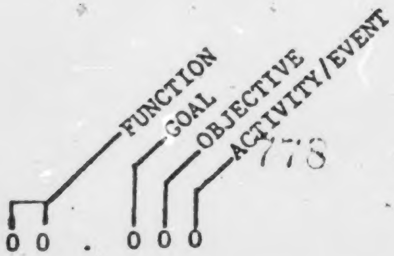
    09.1 Basic education
    09.2 Higher education
    09.3 Business and industry

10. ADVISORY COMMITTEES

11. GRANTSMANSHIP

FIGURE 4

MODEL FOR INDEXING GOALS AND OBJECTIVES



A second objective of this presentation is to describe the budgeting process and a method for relating fiscal resources to institutional goals and objectives.

An important step in the development of the planning process is the interface of the budgeting process. The budget is clearly the institution's most important and significant statement of resource allocation and use. Through the budget, the president and the administration of the institution present an assessment of the institution's problems annually and, indeed, proposals for dealing with them. Budget is then the vehicle for communicating details of the president's assessment and recommendations. The budget is the chief instrument for forcing and recording executive decisions about institutional priorities, objectives the institution should seek, the share of the institution's resources that should be dedicated to each area, and how costs should be distributed and underwritten. The annual review necessitated by the preparation of the budget also gives the president and the administration an opportunity to weigh the effectiveness of the institution's programs in achieving their purposes, and to consider how they might be improved. Skillfully handled, the budget can become an invitation to institutional creativity rather than bureaucratic drudgery. The process of interfacing the institutional budget with the comprehensive academic planning process will be referred to as "The Alternative Base Concept." ABC is a planning/budgeting process, a way of relating dollars to the organization's goals and objectives through the careful study of alternatives.

At the offset of the explanation of this process, let it be clearly stated that ABC budgeting system must be tailored specifically to the needs of each individual institution. Although the planning principles will remain the same, each institution must consider a number of factors which, in all probability, make it different from any other institution. These factors may include:

1. Variation in organizational structure.
2. Current institutional decision-making process.
3. Maturation in institutional planning.
4. Variation in funding sources.
5. Significant differences in the planning calendar.

Within the format of ABC budgeting, alternative base concept is a logical step-by step approach to budget building, which may be adopted with the five previously mentioned variables.

In a climate where it has become common folklore that of all our social institution's most resistant to change, cemeteries and institutions of higher learning must surely rank at the top, we are fortunate to have at hand a planning process which is designed to produce change.

The concept of the ABC budget process is to build a budget by establishing three alternative budget bases. The first alternative is a continuation budget base, referred to as maintenance level. The alternatives utilized in establishment of this base may be to assume no increase from the current level expenditures, specific percentage increase, or a specific percentage decrease from current level of expenditures. These alternatives allow the cost center to realign expenditures by object code within specific guidelines. The cost center may further elect to reduce expenditures, or to transfer certain expenditures into another cost center, as long as totals do not exceed maintenance level guidelines.

The second major alternative is a reduced budget base, referred to as skeletal level. The concept is for the cost center to rank a series of reductions within specified percentage levels from the maintenance level. North Central Technical College in the current fiscal year assigned reductions from 1% to 10% reductions to be developed, ten in all, each representing an additional

1% reduction from the maintenance level. These reductions are further prioritized so that the first level reduction would create the least effect on the productivity of the cost center.

The third major alternative planning tool is called expansion package. Expansion package alternative budget base is actually an optional "wish list" of expenditures put together in packages addressing one or more objectives. This approach considers the possibility of additional expenditures beyond maintenance level of operation. It is optional in the sense that not every cost center may find it necessary to request additional funds. Expansion packages are ranked in order of importance to the cost center.

Each of these budgets is inter-related in the budget building process and yields a number of alternatives at each stage of the planning process. These alternatives provide both current and future flexibility should plan or resources become altered.

Figure 5 describes the ABC budgeting process. Across the top of the chart are indicated the five decision units that interact to produce the budget document. Although the title of these groupings may vary from institution to institution, their responsibilities within the framework of the planning process will be very similar. The cost center is a unit or natural grouping of activities in an institution's operations for which costs are collected. These elements or segments are budget units for which expenditures are planned. The academic council is comprised of division and program directors. The President's cabinet consists of the chief executive officer of the institution and the institution's three vice presidents - academic affairs, student services and business and finance. The Board of Trustees is the final policy-making group of the institution.

The Budget Committee is comprised of a cross section of the College. Because every faculty and staff member of any given institution is involved in the utilization of college resources, the entire college community, including student representation, should be involved in fiscal planning. At North Central Technical College the Budget Committee was comprised of two representatives of the academic council, one faculty member from each of the four technical divisions, two representatives each from student services, classified staff, and the student advisory board, and was chaired by the vice president for business and finance.

The first series of steps involved development of goals and objectives by the cost centers, with subsequent review by the academic council and the President's Cabinet, with final approval by the Board of Trustees. Following this final approval, the goals and objectives go to the Budget Committee for familiarization, and from the Board of Trustees to the President's Cabinet with guidelines for the development of the institutional budget. These guidelines will address themselves to:

1. Maintenance level for cost centers. Prior to furnishing of guidelines, basic work is done by the chief fiscal officer denoting projected income in the form of parameters indicating minimum and maximum expected income for the budget period.

2. The President's Cabinet furnishes a guideline for skeletal levels so that each cost center will project well within the maintenance level projection.

The cost centers then develop budgets relating dollars to goals and objectives. Maintenance levels can be reduced where dollars are not required to support on going programs or where goals and objectives have been reached. In addition to the maintenance and skeletal levels, budget centers may project expansion levels for achievement of additional goals and objectives should additional dollars become available. The Budget Committee rank orders expansion packages and makes recommendations to the academic council and the President's Cabinet. Budget packages may be referred back to the cost center and again to the Budget Committee for further development and review. The President's Cabinet, with the help of the academic council, reviews the budget and places its own recommendations on expansion packages if they vary from that of the Budget Committee. The recommendations and comments of the President's Cabinet are shared with the academic council and the budget committee prior to the finalizing of the budget through action by the Board of Trustees. The Board of Trustees has the alternative of approving or requesting revision of the final budget. In the case of a request for revision, the entire step regarding development of budgets with review and recommendations would again take place prior to another presentation to the Board of Trustees.

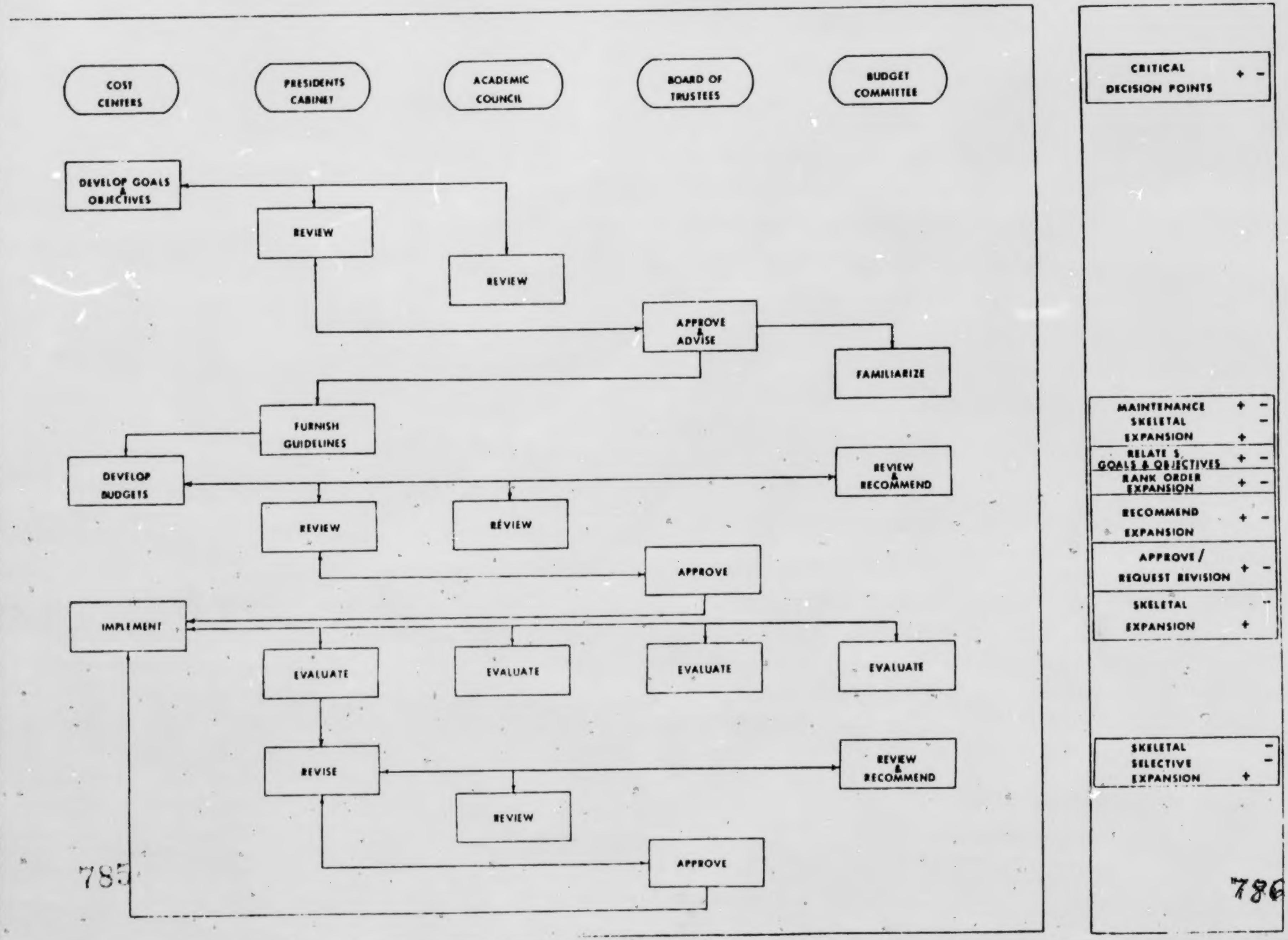
Following the Board of Trustees approval of the total budget, it is released to the cost centers for implementation. At that time, if projected income is better known, the approval will request the addition or deletion of funds through either levels of skeletal budget released or level of expansion packages released. During this series of reviews, the budget may be altered by variations in income through additional application of skeletal level deductions, further release of dollars for additional priorities of expansion packages, or the possible selective decrease of budgets with review and recommendation by Budget Committee, President's Cabinet and the Academic Council, and of course, final approval by the Board of Trustees. In most instances boards of trustees will allow administrations to handle minimal changes in total budget without requiring additional approval by the Board.

Evaluation, revision and review are constant effort by the President's Cabinet, the Academic Council, the Board of Trustees, and the Budget Committee. Revision may be made at any critical point during the fiscal year with the use of predetermined skeletal and expansion package formulation. Only when income drops severely below projected skeletal base projections, will it be necessary to go back to the cost centers for additional budget revisions. Once the three budgets are developed by the cost centers, they are relieved of the requirements of budget development until the next fiscal year.

Examination of the responsibilities on a vertical line under the developing bodies indicates that cost centers develop goals and objectives, develop budgets, and finally implement these budgets. The duties of the President's Cabinet are mainly to review, furnish guidelines, evaluate the results, and in some instances revise budgets. The Academic Council reviews and evaluates the budget and the Board of Trustees approves, advises and evaluates. The Budget Committee has a duty of familiarizing themselves with the goals and objectives and to review, recommend, and evaluate the development of budgets and the results thereof. The process may be described as a two-way process of recommendations and communications.

Although the final budget recommendations are the responsibility of the administration of the College, the ultimate budget decision rests with the College Board of Trustees. Because the educational enterprise is run on a bottom line measured by service as opposed to profit, the process lends itself to interaction by dedicated individuals involved in different functions of the institution to focus on purposes and outcome based on the organization's mission, goals and objectives.

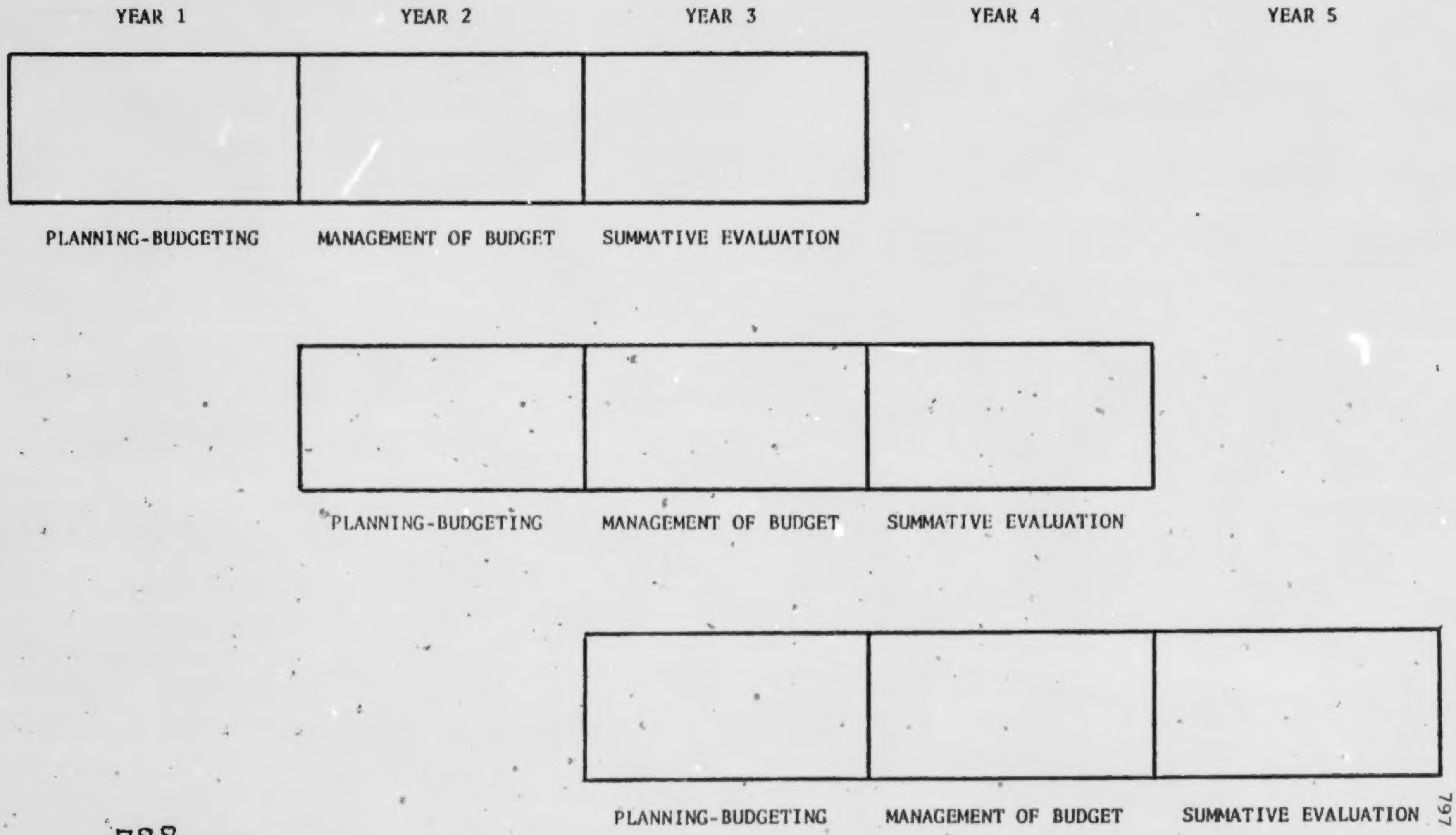
FIGURE 5 THE BUDGET PROCESS



A third objective of this presentation is to discuss the relationship between data and its use in a planning, management, evaluation (PME) system. The first section of this document described in some detail a planning process. The second section of this document described a budgeting process for relating resources to goals and objectives. That which is planned for during one fiscal year will be managed (implemented and coordinated) during the next fiscal year. Evaluation will occur both during the years the processes of planning and managing takes place as well as during the following year. If an institution improves its planning-budgeting process in Year 1, a formative evaluation occurs that same year followed by a summative evaluation sometime later. During Year 2, an institution can improve its managing-budgeting process. A formative evaluation of the managing-budgeting process will be made during that year followed by a summative evaluation sometime later. This concept is basic in order to understand the relationship between data and its use in a PME system. The PME concept is displayed in FIGURE 6.

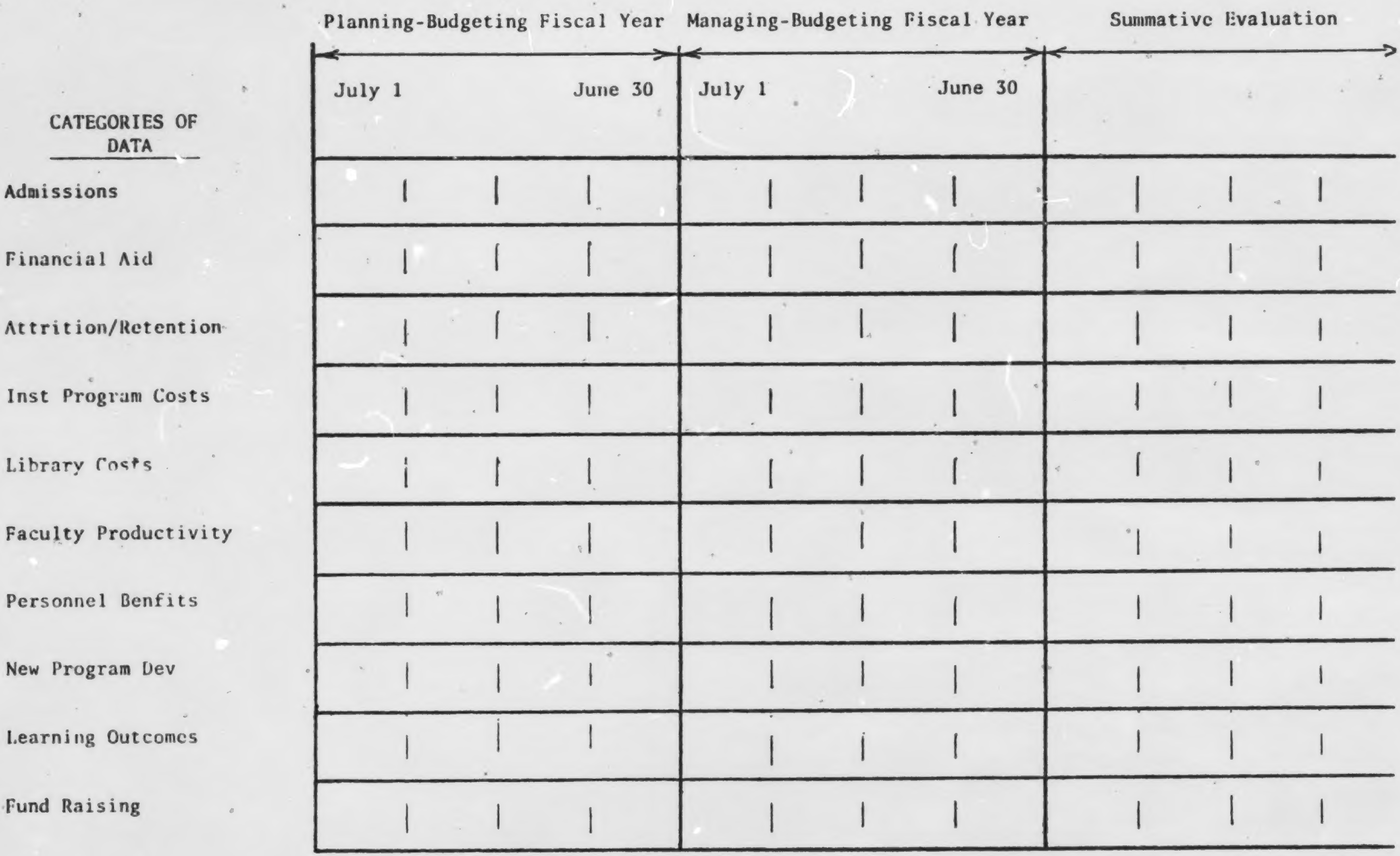
As indicated earlier in this presentation, organizations strive to gather facts and put them together to produce meaning. These facts can be aggregated under categories such as (1) admissions, (2) financial aid, (3) attrition and retention, (4) instructional program costs, (5) library costs, (6) faculty productivity, (7) personnel benefits, (8) new program development, (9) student learning outcomes, and (10) fund raising. These categories are not original. They represent modules developed in the Planning and Data System (PDS), a project by The Council for the Advancement of Small Colleges and generously funded by the Carnegie Corporation of New York over a five-year period. Each of these modules can be used independently to deal with a specific institutional concern or the modules can be linked in ways that deal with a larger set of concerns.

FIGURE 6 THE PLANNING, MANAGEMENT, EVALUATION CONCEPT



For purposes of discussion, let us assume that an institution had a desire to penetrate further the traditional college bound student market as well as the older adult markets within a geographic region. Such a stance would require data about potential client markets and their specific educational needs as well as ongoing program cost in order to reallocate resources to accomodate new programs. Data play an important role in the planning process as well as in the management and evaluating functions. It seems logical, therefore, to create a model for the display of data for use at critical points in the decision-making process during the planning/budgeting fiscal year as well as the managing/budgeting fiscal year. Such a model is displayed in FIGURE 7. Instructional program costs and attrition/retention data are particularly important to make GO/NO GO about the continuation/discontinuation of specific programs. NO GO decisions about particular programs could provide resources to make GO decisions about new programs. Admissions data and attrition/retention historical data are necessary to project future enrollment and anticipated revenue. Admissions data at the beginning of the term are essential in making adjustments during the managing/budgeting fiscal year. Thus, an institution can develop a matrix for sideplaying critical times for reviewing categories of institutional data during the planning/budgeting and managing/budgeting fiscal years.

FIGURE 7 DATA AND DECISION MAKING



CONCLUSION

How well higher education meets the needs of its students and the society in which it exists is a function, for the most part, of its degree of sophistication in planning, comprehensive, long-range, and systematic. Critical as institutional planning is to a college's survival, only a very small number "have effectively developed a plan, based on sound data about themselves and their setting, which is revised at least annually and upon which the institution's leadership acts daily".[1]

A comprehensive planning process includes (1) a planning protocol, (2) a planning structure, (3) external and internal assumptions, (4) goals and objectives, (5) a method for developing programs from high priority goals, and (6) an evaluation protocol. Planning is a primary administrative function antecedent to managing and evaluating. A Planning, Managing, and Evaluating (PME) system is firmly based on an organizational process which strives to gather facts and put them together to produce meaning. These facts are linked to the mission and essential purposes of the institution and can be aggregated under categories such as (1) admissions, (2) financial aid, (3) attrition and retention, (4) instructional programs costs, (5) library, (6) faculty productivity and reward structure, (7) personnel benefits, (8) new program development, (9) student learning outcomes, and (10) fund raising.

Data are the foundation upon which to build the multi-year institution Plan, a document containing a grand design representing intelligent anticipation of activities, events, and experimental observations carefully specified in advance to move from one point to another. Data are needed (1) about environmental assumptions upon which to base planning; (2) about potential clients and unmet societal needs growing out of a needs assessment or market analysis/market segmentation process; and (3) for managing institutional areas as specified above. Probably most important, however, the data analysis process must strive to produce meaning as it relates to efficiency and effectiveness of relating dollars to institutional goals and objectives.

FOOTNOTES

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[2] Final Report, May 1974, p. 15,

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[13] Ernest G. Palola, et. al., "Qualitative Planning: Beyond the Numbers Game," The Research Reporter (Berkeley, California: The Center for Research and Development in Higher Education), Vol. III, 1968.

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[15] Arnold E. Metz, American Technical Education Journal, January-February, 1978, p. 2.

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TRACK V
VENDOR PRESENTATIONS

Coordinator:
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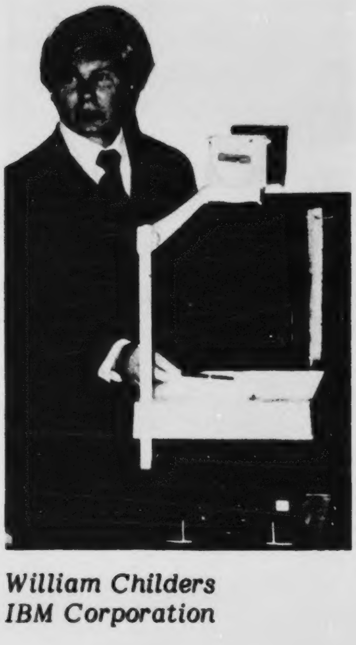
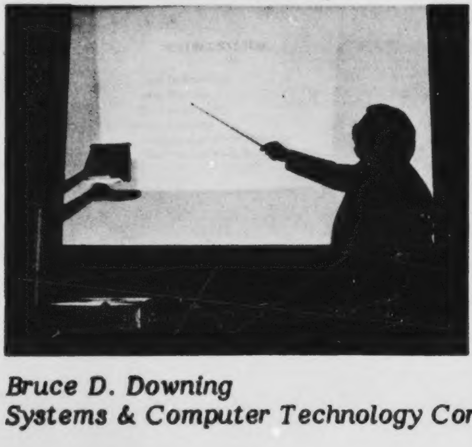
College of DuPage

Arthur S. Walder
Harris Corporation



William Childers
IBM Corporation



Bruce D. Downing
Systems & Computer Technology Corporation

informatics inc
21050 Vanowen Street
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(213) 887-9121 Telex 69-8715
Cable INFORMATIC

TITLE: Programmer Productivity: A Look at the Current State of the Art.
AUTHOR: Marvin Smith, Informatics Inc.

The reason for the great interest in this topic can be summed up by a quote from the authors of Data Processing in 1980-1985. "Productivity of implementors could well remain one of the primary limitations to the industry's growth and its ability to supply needed services."

Twenty years ago about 20% of the dollars spent on data processing was for software. Today it is about 80%. In 1985 it is projected to be 96%.

Productivity measuring and predicting techniques are a long way from being perfected and some experts believe they may never be.

An in-depth study by IBM indicated:

- The average life of a program was between 15 and 16 months.
- The vast majority of programs, in terms of numbers, require only a small percentage of machine time.
- The vast majority of programs cost substantially more to develop than they cost to run over their entire lifetime.

The study concluded that the most effective way to increase productivity, and at the same time have little negative impact on machine resource utilization, was through the use of high level languages.

MARK IV is the most powerful and versatile high level language available on the market today. It has, in many installations, substantially or completely replaced COBOL for new application development.

Data Processing management has an important opportunity to improve the productivity of their programming resources by considering, with an open mind, the use of a high level language.

International Business Machines Corporation

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IBM SEMINAR

Craig R. Bush
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In its supplied form, the Interactive Personnel System is ready to perform a large number of personnel functions (applications). The system can also perform functions specified by the user. To make this possible, a facility called the procedure definition language enables the user with little data processing knowledge to apply the necessary instructions to the system.

The Interactive Personnel System runs in both online and batch mode under DOS/VS with DL/1 DOS/VS and CICS/DOS/VS, or under OS/VS with IMS/VS or IMS/VS and CICS/OS/VS.

For further information regarding these products, please contact your local IBM Marketing Representative.

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-- A New Product From Information Associates --
A System Designed To Bring People And Information Together

The IAI INTERACT SERIES provides integrated software for the college administrator:

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- * IAI FINANCIAL MANAGEMENT: Billing/Receivables, Accounts Payable, Financial Accounting
- * IAI STUDENT/ALUMNI INFORMATION: Admissions, Records, Alumni

All INTERACT Systems use a common Data Element Dictionary that contains institution-wide definitions and descriptions of all data elements. Its design makes it easy for users to change or add to stored information.

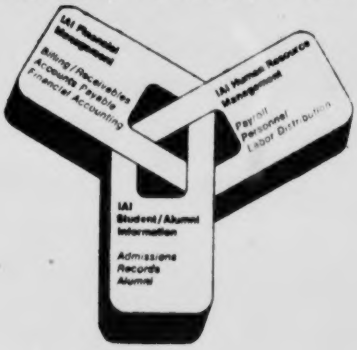
INTERACT processing focuses upon a common People File. That File contains all student, admissions, alumni, faculty, employee and vendor information. Systems access relevant portions of this file as needed to complete processing requests.

Transactions input to any system are automatically fed to related files so that each is always up-to-date. Further, information is fed from one INTERACT System to another.

A built-in Report Generator permits a non-programmer to quickly and easily extract one-time reports without having to depend upon a programmer's availability.

On-line capabilities make INTERACT instantly responsive. Batch processing provides efficient use of computer resources.

This series is currently available on Harris Computers that support ANS COBOL and the VULCAN operating system. Harris Computers are installed in many university locations and feature a wide variety of other languages that make it feasible to support concurrent academic programming.



10th Anniversary — 1978

SYSTEMS & COMPUTER TECHNOLOGY CORPORATION

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THE ROLE OF ADMINISTRATIVE SYSTEMS IN NON-TRADITIONAL EDUCATION

Bruce D. Downing
Assistant Director for
Academic Computing
Cuyahoga Community College

Many institutional leaders are aware that traditional instruction methods do not meet the demands of todays students. The requirements in developmental education, attrition rates and pressures for accountability have led to a wide variety of instructional techniques. Typical goals for new techniques include more individual instruction, better use of faculty time and the management of learning progress.

In the role of facilities management, SCT Corporation has been developing systematic approaches to computer support of instructional processes. Our experience has demonstrated the need for support systems which require integrated administrative and academic processing. Effective instruction requires that faculty are viewed as managers of learning resources and the computer is needed to supply learning management data.

The instructor as a manager of learning resources is concerned with the assessment of student skills and learning strategies, decisions concerning the most appropriate learning tools and the measurement of learning progress. Therefore, the most basic computer support is an adequate test generation and scoring package. Test generation requires the storage and retrieval of test items. Test scoring requires on-line test scoring, item analysis and facilities for storage and retrieval of student records.

The student records requirement implies integration with a general student information system. However, instructional methods allowing students to progress at individual rates requires student tracking which does not fit well with transcript oriented student information systems. The solution requires two levels of tracking, one useful to the instructor for learning management and an institutional reporting system. The instructors' system can provide information to the general student system and fulfill many functions within institutional research.

Implications of new instructional techniques for continuing education, faculty load records and systems management were also discussed. Managers of administrative systems should be involved in planning, implementation and supervision of instructional support systems.

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813

THE CASE OF TRADITIONAL TURNKEY CONTRACTING [1]
FIXED PRICE VERSUS DEVELOPMENTAL CONTRACTING

In the early days of computing, large scale machines were obtained to perform the functions required in the University. These machines were expensive and required substantial software programming and perpetual maintenance. Eventually, enough experience and specification were gained that through the developmental process vendors could quote prices on a turnkey basis. However, since the costs were so high only few and larger institutions were able to experience this process.

Now, we are at the threshold of a new developmental process in computing due to the substantially lower cost of mini-computers. However, the programming costs have not changed or may have increased with the reduced cost of machinery and many more institutions are in a position to purchase hardware, but not in a position to support the software development or maintenance. Unless a mechanism for development of software and its subsequent maintenance is perfected, institutions cannot take advantage of the reduction in machine costs.

Currently, we at ADLS have been trying to solve this problem and have developed a concept which we call an interinstitutional development "cooperative". Currently, the 15 Community Colleges of Massachusetts form such a cooperative and in January results or our initial efforts will be known when we test an on-line registration system.

With this brief background, we turn to the topic of this presentation; turnkey contracting versus developmental contracting. The concept of a developmental cooperative involving 15 institutions which have varied objectives, goals and agendas is boggling. But the contractual forms present an even greater problem. First, there has been no satisfactory standard form of contract which can adequately deal with the complexities of 15 educational institutions and a developmental process all on a fixed price basis.

---

[1] A Turnkey Contract is a contract form which provides a buyer all hardware and software from a single vendor to meet detailed specification contained in the contract for a fixed price.

Faced with this problem, a concept for a contractual form was needed to match the conceptual frame of the interinstitutional cooperative and retain the advantage of a single vendor. The proposed and implemented solution involved the concept of breaking down the elements of a contract into scope, price and changes. If the price was to be fixed and the scope was to be developed or be flexible as the work proceeded, both vendor and institution would need contractual flexibility and a notice procedure to allow the scope of work to change and the price and schedule adjusted accordingly.

On its face this change would be a significant calculated risk to the institution and the vendor unless the changes were dealt with at a very elementary level and could be related back to the contract. To accomplish this review at an elementary level, there are two types of changes. Changes within the scope of the contract and changes outside of the scope of the contract. Upon identification of changes within the current scope of work, resolution is made as to whether they impact price or schedule. If there is no impact on price or schedule, the change is recorded and implemented. If there is a change in price or schedule, the change is presented to the institution with the proposed resolution and upon approval an amendment to the contract is completed.

Likewise, the potential exists in this contract to defer items for future development as changes outside the scope of the present developmental contract. These items are recorded and deferred for future development.

The change process requires close communication and the clear understanding by both parties that a developmental process is occuring. Our experience thus far is that this contractual process does not limit the parties as does a turnkey contract and yet produces usable, hard products unlike study contracts or time & materials type contracts.

BY JAMES K. MEER, DIRECTOR OF CONTRACTING AT ARTHUR D. LITTLE SYSTEMS, INC.

integral systems, inc.
eight main street • flemington, new jersey 08822 • (201) 782 3600

THE HIGHER EDUCATION PAYROLL/PERSONNEL SYSTEM FROM ISI.

At CAUSE, in New Orleans, Integral Systems, Inc. announced the expanded version of its Payroll/Personnel System. This new version of the system incorporates significant expansions - both functionally and technically, which greatly increase the effectiveness of the system in diverse, higher education environments.

Functional expansions to the ISI System include: The addition of further table-driven functions to control reporting, payroll calculations, and other functions; the provision of options for detailed labor distribution and cost accounting, for applicant accounting, for benefits statements, for benefits reconciliation, and for injury and accident reporting. These new options and expanded functions, make the ISI System the most complete system for higher education available.

Technical expansions in the ISI System include the provision of facilities for operation in various data base environments and the provision of various levels of on-line operation to allow the system to be installed in either a data base environment or an on-line environment, or both, on a module by module basis.

The ISI System's primary modules and options are listed below:

Modules:
- Personnel Records
- Payroll Processing and Reporting
- Personnel Reporting
- Position Control

Options:
- Report Generator
- Applicant Accounting
- Expense Distribution
- Labor Distribution/Cost Center Reporting
- Benefits Reconciliation Reporting
- Benefits Statements

The modules and options available with the ISI System enable an institution to choose those suited to its unique environment. For further information on the ISI System contact:

Michael P. Aherne
Integral Systems, Inc.
8 Main Street
Flemington, New Jersey, 08822
Telephone: (201) 782-3600

or

Michael E. Hastings
Integral Systems, Inc.
35 Quail Court
Walnut Creek, CA. 94596
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PANSOPHIC PRESENTATION

Robert S. Briggs
Midwest Regional Manager

Control and security have become almost synonymous in our terminology today. When people discuss security, they relate to information that will provide audit trails of the computer activity. The ability to provide information for control purposes and one-time reporting has been present with EASYTRIEVE, the Report Generating and File Management System, for a number of years. However, until PANEXEC, the Executable Library Control System, not enough information was really available to provide true audit trails. A modified version of EASYTRIEVE has been incorporated into PANEXEC, so that reporting on over 150 fields of needed information captured by PANEXEC can be delivered in a timely fashion.

For more information contract:

Robert S. Briggs
Midwest Regional Manager
Pansophic Systems Incorporated
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Oakbrook, Illinois 60521
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Honeywell

HONEYWELL INFORMATION SYSTEMS MULTICS/USL PRESENTATION

The HIS presentation consisted of two segments: One, a Honeywell presentation dealing with the history and capability of MULTICS; the other by the director of the computing center at the University of Southwestern Louisiana, Ms. Della Bonnette. This segment dealt with the use of MULTICS at USL.

HONEYWELL MULTICS is one of the most powerful and comprehensive large-scale systems in the world today. MULTICS offers a broad range of features and capabilities, within a service-oriented environment--and addresses the reliability, availability, and system growth requirements of distributed processing users.

PROCESSING CAPABILITIES

MULTICS is a total online, interactive system ideally suited to a variety of processing activities including:

Batch--local and remote.
Time Sharing--full time sharing capabilities.
Transaction Processing--terminal oriented.
Word Processing.
Graphics.
Real-Time Processing.

EASE-OF-USE FEATURES

Interactive Orientation of all Facilities

Every aspect of MULTICS is online-oriented, including the language processors, applications, data base management facilities, utilities, administrative tools, and metering tuning capabilities.

No JCL

Unlike other systems, the MULTICS operating system provides control functions via a standard command processor approach, thus eliminating complex, differing JCL.

VIRTUAL MEMORY

MULTICS virtual memory is transparent to user programs. Programs written for the largest configuration can run on the smallest without modification. No standard, fixed, main-memory-to-mass-storage ratio is required to ensure efficient system operation.

PROGRAM DEVELOPMENT

Fully compatible language processors contribute to the system's outstanding program development capability. These processors--including PL/I, COBOL-74, FORTRAN, APL, ALM (assembler), and BASIC--can be fully shared.

DATA BASE MANAGEMENT

The MULTICS Data Base Manager (MDBM) offers Integrated Data Store (MIDS), a subset of I-D-S/II; and Relational Data Store (MRDS).

EASE OF OPERATION

There is no system or library generation or edit. The operator can start the system simply by typing one command at the console. System software and libraries can all be updated online and can be installed without affecting users working with other existing packages.

DISTRIBUTED SYSTEMS ORIENTATION

MULTICS is ideally suited to the development of networks of distributed mainframe systems. For example, a programmer could log onto an IBM 370/158 then have required data transmitted from a CDC-7600 to MULTICS for processing, with the output going to the 370.

SECURITY

MULTICS offers high levels of security unattainable on other systems today. Several elements cooperate to make this outstanding system, data, and program protection possible. These elements are passwords, access control lists, multistate ring protection mechanisms, and access isolation methods. No special coding is required to make use of any of these elements; only standard system commands need be executed.

MULTICS AT THE UNIVERSITY OF SOUTHWESTERN LOUISIANA

An engineering student compiles and stores data for the design and simulation of electrical circuits. An accounting employee enters overtime information for the weekly payroll. A history professor inputs facts for a study of eighteenth century French provinces. A teaching assistant keys in last minute changes to a faculty member's book being composed and edited online.

At the University of Southwestern Louisiana (USL) in Lafayette, these and many other activities can and do occur simultaneously.

MULTICS offers performance levels that can easily accommodate the University's varied instructional and research projects and ever-increasing administrative data processing workload.

Soon after the installation of MULTICS, USL students, faculty members, and administrative personnel began using its advanced technology on projects ranging from computer science research and simulation to instructional problem solving, text editing, and registration.

Classroom Instruction. In the Computer Science Department, for example, students receive instruction in subjects such as languages, data management systems, and compiler writing. Then, they go to the terminal to apply what they've learned.

Text Editing. MULTICS' text editing functions are being used extensively by graduate students preparing their theses. The MULTICS Run-Off facility establishes the format for each page; the student can define margins, line spacings, headings, footings, etc. Once these are established, the system prints the draft offline for proofreading and errors can be corrected from the terminal. Any additional text can be inserted appropriately, and the system will reformat it automatically.

Registration. Students simply fill out registration cards containing desired courses; the cards are then read into the system. MULTICS checks whether selected courses are open and, if so, issues the schedule.

Other systems include payroll, AR/AP, and other financial and administrative systems.

Security Features. For example, a professor wishing to share some research information with colleagues or students, can grant limited access to some of the files. The shared information does not have to be extracted and copied, but can be accessed from different terminals. File access can be controlled using access commands.

GROWTH. Like other Honeywell systems, the MULTICS hardware architecture provides modularity and paced growth that does not require swapouts to upgrade to higher performance levels. It is not necessary to change the operating system, system libraries, or user codes in order to move to a more powerful MULTICS system.

MSA

THE FINANCIAL SOFTWARE COMPANY

THE MSA APPROACH

Management Science America, Inc. designs, programs, documents, installs and supports a series of financial and human resource application systems. These systems, along with the support and continuing enhancement and maintenance services provided by MSA are termed "software packages" within the industry. Each package is designed with options and "parameter flexibility" so that it can be utilized in a multitude of companies, industries and computer operating environments.

This philosophy of software development enables MSA to devote design and programming resources to continue enhancement of generalized packages, without having to devote a large percentage of resources to the support of existing customers. On the other hand, customers receive enhanced systems as they are developed by MSA as part of an on-going maintenance service.

Rather than "customize" the packages for each individual installation, MSA is able to quickly install the software system on a customer's equipment. The installation then proceeds with MSA technical representatives who train user personnel in the use of the system and assist with special problems, questions and choice of alternatives during the implementation process.

The implementation services provided by MSA do not constitute a consulting engagement or a "turn-key" system. Our approach is to "train the trainers" by bringing a user team up to a high level of knowledge about the system and guide them in training the clerical personnel in actual implementation and conversion steps.

The major benefit of this approach is that your personnel are thoroughly familiar with the intallation, operation and use of the system. Therefore, they are easily able to maintain the system, change parameters, options and other data which control its operation to compensate for changes in reporting requirements, organizational structure, and other changes in the environment.

Extensive documentation written specifically for the using department, as well as the System, Programming and Operations Departments, accompanies each system. The documentation, containing numerous examples and illustrations, aids in training employees who are using the system for the first time.

All MSA systems are written in ANSI COBOL, a versatile computer language that can be used on most computers including IBM, Burroughs, Honeywell, DEC, NCR, Amdahl, Itel and Univac. As enhancements and other modifications are developed by MSA, they are distributed in source and/or object code, depending on the extent of the modifications. These enhancement are then installed by user personnel to upgrade the system to the current MSA operational level.

This program of continued enhancement, software warranty and maintenance insures that users of MSA systems will continue to have the most current, up-to-date system from both a data processing and application standpoint. It is the major factor which sets an MSA "package" apart from inhouse developed or other "custom" software systems.

More than $1 million is spent each year in ENHANCING the systems through research and development to meet changing needs. These expenditures result not only in systems that comply with the various federal regulations affecting their use, but they also result in systems equipped to utilize state of the art features such as data base management, on-line processing, and structured programming. These ongoing enhancements are continuously available to MSA customers through the warranty accompanying each system and the extended maintenance agreements.

Another great advantage is the fact that the system can be installed much more quickly than one which must be partially designed, coded and tested. The overall implementation timeframe (and cost) can be shortened significantly by allowing accounting users to "get involved" in the system more quickly.

Because the education sector is a rapidly growing portion of MSA's activity, users in this area have a strong impact upon the MSA system enhancement program. As more input comes from these new users, a larger portion of our planned system improvements are directed toward meeting their unique requirements.

The MSA General Ledger System offers many advantages to colleges and universities such as:

- The ability to account for Grants utilizing a fiscal year differing from the institutions.
- User controlled reports by responsibility structure as well as by fund.
- The ability to change functional or organizational structure without opening and closing accounts.
- The ability to produce all user defined reports with one pass of the General Ledger Master file.
- The ability to allocate indirect costs on selected statistical basies for calculation of indirect cost rates for grant administration.
- On line edit and inquiry capabilities.
- The calculation of available funds for any budget category or account is updated with each online or batch entry to the General Ledger.
- The ability to use a user defined algorithm against current and historical financial and statistical data to provide an initial budget document.

MSA offers a set of systems that can be implemented separately but they can also function as a single unit. They are an integrated financial management system.

Human Resources
- .Payroll
- .Personnel
  - .Position Control
  - .Employee Benefits
  - .Life to Date History
  - .Lost Time/Health & Safety
  - .Applicant Flow
  - .Career Development
  - .Labor Relations

Cash Management
- .Accounts Receivable
- .Accounts Payable
- .Supplies Inventory Control and Purchasing

Financial Reporting and Forecasting
- .Fixed Assets (Property Control)
- .General Ledger
- .Financial Forecasting and Modeling

MSA offers integrated, user controlled and constantly enhanced systems that can be quickly implemented.

For more information on how these systems can function in your institution call or write Jon Gearhart at Management Science America, Inc., 3445 Peachtree Road, N.E., Atlanta, Georgia 30326 or (404) 262-2376.

TRACK VI
CONTRIBUTED PAPERS

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INSTITUTIONAL ADMINISTRATIVE APPLICATIONS OF COMPUTERS IN HIGHER EDUCATION

Kent Weldon
Robert Gray

National Center for Higher Education Management Systems

The age of computers has had a significant impact on the administration of all large organizations. Higher education is no exception with new computer applications continually being advanced in an effort to assist in administrative decision-making. At this stage of development it is useful to examine just how sophisticated higher education is with respect to its use of computers in assisting administrators.

Information obtained from the Fourth Inventory of Computers in Higher Education (FICHE) is anlayzed in order to address the following two research questions:

1. What are the patterns of computer sophistication across various administrative areas?
2. How do these patterns vary depending on the type, control, and size of the institution?

Interactive Hierarchical Network Models for Planning

Charles Wiseman

Director of Institutional Research

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In a recent study of prepackaged planning models (Campus, Help/plantran, RRPM, and Search), P.J. Plourde concluded that institutions "still express continuing frustrations and cynicism" toward such systems. He noted that models "should fit the institution and not the institution fit the model" and cited user education as "the most difficult goal to reach."

It should be clear from Plourde's analysis and from the reports of others that super models, with all the purportedly essential relationships laid down once and for all, are ill-adapted, like dinosaurs, to their environment. These a priori systems cannot be tailored to the decision making processes of particular institutions by merely turning parameter switches. What is needed are user-developed, hierarchical networks of models that link an institution's planning units. Each institution needs it own network model connecting a financial aid model developed by its director of financial aid, an admissions model by its director of admissions, an academic model developed by its dean, and so on.

With well-defined procedures, hierarchical network models provide a systematic approach, easily understood by users, for model building. Moreover, they are endowed with flexibility, the critical ingredient for success in model-assisted planning systems. Flexibility implies first that users may suggest changes in (1) model assumptions (vary, add, or delete values of exogenous variables), (2) model equations, and (3) report format. Second, flexibility means that model builders may implement these changes with a minimal expenditure of time and effort in an interactive setting. An example of the development and maintenance of such a model will be presented.

THE RELATIONSHIP OF TRANSACTIONAL INFORMATION SYSTEMS TO THE INSTITUTIONAL INFORMATION SYSTEM

BY

W. CHARLES LAW

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A transactional system represents a routine set of procedures for the collection, filing, and recalling of data and information within the standard day-to-day operations of an office. Transactional systems are integral support systems for the information system. In order for an information system to be timely and relative as well as useful in supplying *information*, the data in the system has to be timely and up to date.

Updating of an information system can be approached basically in two ways. These two ways can involve a *historical* or *discontinuous* updating of the data base, or a *developmental* or *continuous* updating of the data base. Within the design of an information system, both continuous and discontinuous updating of the data base may be employed depending upon the needs within specific operational areas identified to support the information system.

DEVELOPING DISASTER CONTINGENCY PLANS: MANAGEMENT CONSIDERATIONS

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This paper discusses methods for examining disaster risks in large computer centers and outlines procedures to respond to a disaster. Details of the University of Illinois Administrative Computer Center and its security concerns are used as examples. A non-sophisticated approach for justifying preventative security expenses is discussed. Some management guidelines for disaster prevention expenditures are presented. Since even careful planning cannot totally prevent a computer center disaster, considerations for actual disaster contingency plans are given. Various management issues for developing such a plan are included, such as: defining a disaster, finding a remote computer site and isolating critical processing.

SNAP/SHOT YOUR ABILITY TO SUPPORT THAT NEXT APPLICATION

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James Winton
Advisory Industry Specialist
IBM Corporation

SNAP/SHOT (System Network Analysis Program-Simulated Host Overview Technique) is a discreet simulation of a network and/or host model available through IBM at the Raleigh Systems Center. The simulator provides an analysis of a total IBM Communications System including a maximum of 100 CPU's and their associated 370X, remote 370X, lines and terminals.

Input data must be obtained from RMF, SMF, and the CICS Analyzer to determine the existing environment and from analysts and users on anticipated applications and their volumes. The simulator permits the introduction of numerous variables in order to evaluate the impact of altering resources such as memory, software, paging devices, CPU's, lines and terminals and altering volumes of transactions, message mixes, size of transactions, etc. The results provide response times by transaction, by line; shows CPU and line utilization, software and 3705 time. Bottlenecks are easy to spot, and the impact of changes to eliminate the bottlenecks can be evaluated by changing parameters and getting another run.

Indiana University has used SNAP/SHOT twice to identify what volume of transactions was supportable on existing equipment and what changes would improve performance. After the first run, a group was assigned to optimize some transactions; and additional memory was added to reduce the paging rate. The second run was made to see what was accomplished and to simulate simultaneous student registration at the six small campuses and then finally adding the large campuses.

Graphs and charts contained in the paper identify the many variables utilized in the processing of Indiana University data and show the results obtained.

HEURISTIC DEVELOPMENT OF A SOFTWARE DESIGN TAXONOMY

Michael L. Rice
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The development of design aid and documentation techniques, such as HIPO and Structure Charts has given the systems designer a way to record abstract concepts. The concepts are problem-solutions which are both machine and language independent. Given that there are a finite number of unique data processing problems, e.g. edit, sort, print etc., it would seem that these new techniques give us a way to solve problems once and avoid costly re-invention. However, this does not seem to be happening.

The reason is that although the techniques allow us to keep good records of our accomplishments, we are not using these records effectively! We do not identify our current task as a previously solved problem and refer to our design notebook for the solution model. Why? Because we do not have a taxonomy of design solutions or a method for classifying them.

AN INFORMATION SYSTEM
TO SERVE
THE CONSUMER AND THE INSTITUTION

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Columbia, Missouri

Faced with eminent enrollment decline, limited resources, and expanded information needs of legislators, prospective students, funding agencies, and other publics, colleges and universities are realizing the necessity for timely accurate information dissemination to a variety of audiences. Many institutions are recognizing the need to present an unequivocal image of what they are (identity), what they do (mission), and who (which markets) they serve. To do so effectively obliges these institutions to assess how they are perceived, to determine what information various publics desire, and to present comprehensive information concisely to their publics.

Development of a multi-stage computer-based "Consumer's Institutional Information System" (CIIS) has begun at the University of Missouri-Columbia (UMC). CIIS is an interactive system designed to:

- provide rapid access and timely updating of comprehensive information describing UMC
- display information in an appealing format concisely tailored to various user (target group) needs
- increase both the magnitude and accuracy of target group awareness of UMC
- enable UMC to monitor and analyze both the information needs of various target groups and the accuracy of their perceptions of UMC

Currently the first two stages of CIIS have been developed as a cooperative venture capitalizing upon the expertise of UMC Colleges or offices of: Engineering, Library and Information Science, Public Information, and Student Affairs.

Using a format analogous to computer-assisted instruction, Stage I of the system has been titled the "UMC Quiz". This stage enables the public to learn about UMC by playing a computer based quiz game focusing upon various aspects of the campus. Participants choose any of nine interest areas and one information category within that interest area. Using a CRT, the participant is then presented a series of quiz questions about UMC. Although the participant is typically presented only a dozen questions and correct responses after the question has been answered, the system contains over 400 quiz items and a variety of response formats (eg. multiple-choice, fill-in, open-ended). The system also provides a printed personalized memorandum of each participant's transaction with the system at the end of their session. In addition the UMC Quiz maintains an internal log of each transaction to support institutional research by (1) providing data reflecting frequencies of consumer interest (interest categories chosen) by characteristic of participant (biographical data), and (2) frequencies of accurate and inaccurate responses representing public misperception of UMC.

Stage II entitled "The Information Station" allows the user to specify their information needs by creating a set of appropriate key words rather than by selecting a preexisting information category. Based upon the keywords specified, the Information Station returns appropriate paragraphs of information describing UMC reflecting the user's interest. This stage operates in a manner analogous to library retrieval of citations. Although currently the Information Station only contains information similar in content to that in the UMC Quiz, it has been designed to handle substantially greater volumes of information across many dimensions of UMC, and can be partitioned into data sets associated with and designed for specific target audiences.

Both stages I and II of CIIS are "transportable" by the nature of their use of computer terminals. They have been designed to provide different formats to appeal to different audiences. The UMC Quiz has appealed to prospective and newly enrolled students and their parents, while the Information Station appeals to returning students and alumni. Subsequent stages will focus upon the general public and legislators.

CONSTRUCTIVE MANAGEMENT CONCEPTS FOR MIS

Written By

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and

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An institution's investment in a management information system is difficult to assess in terms of resources expended. Each institution expends resources directly for information system personnel, hardware, and software. An institution's MIS feeds upon its resources and it is unquestionably a vital component in its management.

The quality of the MIS is, however, determined as much by the quality of management that controls the MIS as by level or resources expended. Therefore, focusing of efforts on the improvement of the MIS by making the management thereof more effective has great potential for improving the MIS and providing an overall improvement in cost/benefit performance.

In this paper the writer examines some methods for improving a MIS through: (1) commitment, (2) participation, (3) communication, (4) continuity. Frequently, overlooked methods that can provide an increment in performance are described and illustrated. The overall focus of this paper is on important concepts that are frequently overlooked in the management of MIS.

DECENTRALIZATION OF MANAGEMENT IN COLLEGES AND UNIVERSITIES

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Partially funded by a grant from the Exxon Education Foundation under the Resource Allocation Management Program (RAMP), Alfred University has developed a management information system intended to support decentralized management. This means that the decision making process and responsibility for budget preparation and its administration is delegated to lower level managers. In order to achieve this goal, new information systems were designed and implemented, and existing systems were modified to provide the complete data needed by academic managers and administrators of the university.

Curriculum interaction reporting showing both the instructional areas contribution to various student majors, and student majors consumption of academic areas instruction was developed and implemented. The National Center for Higher Education Management Systems (NCHEMS) program costing model, Resource Requirement Prediction Model (RRPM-1.6) was implemented to provide program cost data. Data from the three academic years, 1975-76 through 1977-78 were processed and analyzed with both the curriculum interaction and program costing systems.

"A Five Year Perspective" of the university was developed utilizing a 1-3-5 year goal concept to detail the goals of individual areas within the university over the academic years 1977-78 through 1981-82. These goal statements are to be aligned with the budget preparation during this time period.

A detailed budget prepartion process was developed from income estimation through final budget approval by the Board of Trustees. Third and fourth level managers were given the responsibility for decision making of budget preparation and revisions as necessary. The goal was to develop a balanced budget, by major area within the university, based upon the income allocated and budget requests from departments within these areas.

In order to inform the academic managers of the process involved and information available for their use in decision making, a training program was developed. A user documentation manual was published providing information as to what reporting is available from the information system, and how it could be used in the process.

Feedback and evaluation process was structured within the system. For instance, alignment of the 1-3-5 year goal statements to actual budget requests and approval; accuracy of approved budget to actual expenditure; does the information system provide the data and reporting needed to make proper decisions; does the university continue to use the system over a period of time; and are budgets balanced to allocated income with a few or no budget revisions?

THE EDUCOM FINANCIAL PLANNING MODEL IN USE OVER EDUNET

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After a feasibility study indicated widespread interest among college and university administrators for access to an interactive budget and financial planning system like the Stanford "Trades" Model, EDUCOM began development of such a system early in 1978. The resulting system, EFPM, the EDUCOM Financial Planning Model, is already in use at Boston College, Carnegie-Mellon, Harvard, Oberlin, and Yale, and is expected to be in use shortly at Colgate, Cornell, Mills, Louisville, and Stanford.

The system is general enough to accommodate large and small, public and private institutions. The design separates the interactive terminal operating program from the institution-specific content, all of which is specified by the user in external self-documenting data files. The data files include definitions of the variables, relationships between the variables, step increments, contraints, and report contents. Each institution custom builds a model from the ground up, subject only to the limit of 560 variables.

Once the data files are created, the user runs the model from a computer terminal, specifying through a question and answer dialogue the alternative values of the variables, the functions to be performed, and the reports to be generated.

A key design decision concerns user access--should EFPM be an exported system to be mounted on the user's computer, or a network system based on one host computer with dial-up access? EDUCOM decided on the network strategy. The computer chosen was the IBM 370/168 (CMS) at Cornell University, and the network chosen was EDUNET, a nationwide facilitating network of university computer centers with local access in over 200 cities in the U.S. and Canada.

EFPM is being used for financial planning in central administrations, as well as in sub-units such as libraries and buildings and grounds departments. Non-financial applications such as faculty flow models have also been implemented.

IMPLEMENTATION OF A PLANNING PROCESS AT THE UNIVERSITY OF ALABAMA IN BIRMINGHAM

James K. Murdock
University of Alabama, Birmingham

This paper focuses on an institutional management and planning office perspective of the development and installation of an academic planning process at the University of Alabama in Birmingham.

The methods, rationale, expected outcome and long range implications of academic program planning will be presented in the context of a first major effort by this institution to install an academic program planning process.

FEEDBACK AND FEEDFORWARD CONTROLS IN ADMINISTRATIVE SYSTEMS

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Use of computers in the university environment has changed in recent years. Administrative systems have begun to show their potential, and this paper examines the controls and participation necessary to have successful administrative information systems.

The traditional administrative systems have been a major source of information and communication in the university community. However, the enormous effort to develop these systems has not been properly appreciated, and little of the information is used in making policy decisions of any consequence.

Two of the things that have contributed to this situation are the concept of control and proper participation in the design and implementation of administrative systems. A control system as seen from the management viewpoint provides methods for reflecting what has happened and predicting what will happen in the future. An even better method of control is a combination of the two. The other area of importance is participation. It is absolutely necessary to design from the top down. The administrators who have an interest in the system should actively participate in the design and implementation.

The author reviews the development process at Virginia Polytechnic Institute and State University and the major systems that have been implemented. The new position of Coordinator for Management Information Systems is examined, and its relationship to the problems of information systems if fully examined.

The paper concludes with a review of the major information systems at Virginia Polytechnic Institute and State University and how they rate within the management concept of a control system. The author also reviews the participation that took place in the design and implementation.

The university environment can make use of information systems, but the concepts of control and proper administrative participation are necessary ingredients for success.

IDENTIFYING THE INSTITUTIONAL INFORMATION NEEDED TO ADDRESS EQUITY ISSUES

Sherrill Cloud
Wayne Kirschling
Dennis Jones

National Center for Higher Education Management Systems
(NCHEMS)

Abstract of Paper

Institutions are having a difficult time being proactive with regard to equity issues; rather, they find themselves reacting to external initiatives. This generally has meant providing substantial amounts of information to meet external demands. A broader perspective that promotes a systematic and routine, rather than ad hoc, response to both external and internal information needs is needed. New approaches to the information problem in the equity arena need to be thought through. While information by itself will not solve a single equity problem, it is an essential foundation for improving institutional capabilities to address equity issues.

During 1978-79, NCHEMS will initiate a multi-year project regarding equity information. A framework of equity information will be designed that will describe and structure the key information that could be developed and used by institutions as part of their activities relating to or impacting on equity. This framework will be far broader and more structured than current federal requirements. The framework will then be incorporated into a document that will also identify the kinds of equity information required for institutional management and external reporting, suggest ways in which the information can be analyzed and used in the context of different institutional decisions and processes regarding both students and employees, and provide references to

sources of equity-related data. This project will also be concerned with developing a broader and more definitive vocabulary to better identify equity issues and concerns and with suggesting institutional equity objectives.

This paper describes the current general perception of the term equity as being limited to federal requirements and legally protected groups. The changes needed to gain a broader and more structured concept of equity and to help institutions regain the initiative in this increasingly important area are summarized. Lastly, NCHEMS activities in regard to developing and structuring equity information and evaluating equity successes are described.

HOW TO JUSTIFY A MAJOR COMPUTER UPGRADE

by

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The Mississippi Gulf Coast Junior College is awaiting delivery of a new Univac 90-30 computer system that will encompass the entire instructional program of the college; both academic and technical student requirements; and will provide for major improvements in the administration and management of the college. Additionally, some capability will be made available to nearby county school systems and other governmental agencies. Planning for this moment has been on-going for more than eight years. Major steps taken during this eight year period of overall planning, with feverish activity for the past two years, are documented in some detail.

It is truly a "how to" paper. It is "how to" because it describes how this junior college in South Mississippi developed a system for providing information for management in 1970; how that system was implemented on a small computer that was far too small to even consider attempting such an endeavor; how that computer system became saturated - with numbers of applications and transactions, and still was a major teaching tool for a technical data processing; and how the present state of waiting for delivery actually came about.

The latter steps were grubby in that literally hundreds of hours were expended by the authors in identifying specific needs that would stand up under the scrutiny of an economy-minded administration and Board of Trustees and under the microscopic review of a powerful state-level Central Data Processing Authority, which was established by statute to oversee data processing expenses in the State of Mississippi and insure that every data processing dollar was well spent and stretched to the limit. The college knew that the need existed, but proving it is what took the time.

In the academic area, by reviewing catalogs of state universities to find majors in those institutions who had to take data processing courses in their freshman and sophomore years, 1500 MGCJC students enrolled in Fall 1977 were found who should take those courses at the junior college, if the junior college were able to teach them; which it could not do without a major computer.

In the technical area, 33 data processing centers were identified in the college district with over 450 employees. The college has one Business Data Processing Program in one of the four counties of the district. The county employing over 250 of the total data processing employees has no program. Multiprocessing and telecommunications are employed in a large percentage of the centers. Neither is taught in college programs because the present small computer is not capable of multiprocessing and it is not economically feasible to tie any terminals to the computer.

In the management and administrative area, the college communicates presently with the computer center via three courier runs each week. A dire need exists for immediate access to computer capability from the two distant campuses in the areas of student services, finance, personnel, payroll, facilities, curriculum, and other areas of interest to the college management team. Methods for accomplishing this are detailed in the paper.

It is not claimed that what the college did will work for anyone else, but they worked for the Mississippi Gulf Coast Junior College, and it is hoped they will work for others. As to success of the college effort, the new computer should be installed in January 1979.

BENEFITS AND PIT FALLS TO DISTRIBUTED PROCESSING

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The trend toward off-loading centralized data center activity to distributed processors continues to expand at a rapid rate. The problems associated with implementing this style of data processing are not simple and should be planned before a committment is made. This paper deals with the replacement of a remote job entry workstation (Data 100) to a distributed processing computer (Harris 135) that provides RJE, timesharing and data entry services in addition to local batch processing. Benefits and problems associated with hardware acquisition, processing concepts, manpower training, and staffing will be discussed.

BATCH PROCESSING OF ADMINISTRATIVE DATA: CAN WE AFFORD IT?

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Is there a University Information Systems Manager who has not felt the pain of providing information in response to demands by HEW, the State legislature, the Regents, or, heaven forbid, your friendly Institutional Research person, only to find significant amounts of the data inaccurate, inconsistent, out of date or missing?

This paper explores the still popular myth that online administrative data processing is a luxury reserved for the wealthier universities. It examines briefly how we got from the quill pen to where many of us are today. It makes the point that batch data processing has done pitifully little to aid in the management of the university as a whole or the management of multi-university systems where these exist.

The paper then describes a series of decisions made at The University of West Florida to change computer-stored information from a state of distrust and marginal use on the part of managers to one of reliability, availability, and usability.

A FACULTY INFORMATION SYSTEM

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This paper describes a system for reporting faculty effort which fulfills and reconciles highly sensitive and mutually opposed federal and state regulations for the use of faculty resources, while meeting stringent Board of Regents submission deadlines and maintaining accuracy. Problem areas and solutions are highlighted and plans for modifications to satisfy the new OMB-HEW procedures for establishing overhead rates for federal grants are discussed. Reporting considerations include the State of Florida 12 Hour Law, which requires a minimum of 12 contact hours per quarter for full-time instructional faculty (a reduction in reported instructional activity below 100% reduces the required contact hour load), pay incentives for faculty with 50% or more effort in instruction, certification of contract and grant funded activity and cost sharing, monitoring faculty activity to spot potential faculty grievance areas (a result of recent unionization), driving the PDM module of NCHEMS IEP (reported to the state legislature), and the contract and grant overhead cost recovery study.

Crucial to this system is the ability to provide department chairpersons with all the information ncessary for intelligent, accurate reporting--cumulative payroll information, course load information from the Registrar's Office, and cost sharing information from the Contracts and Grants Office--when the quarterly survey is completed.

The system is implemented using the Informatics Inc. MARK IV data base management system with Extended Features. Coordination of four major data files with updating and reporting are the major features with auxiliary subfile generation useful for special requests.

A CALL FOR DIFFERENT STYLES OF DATA MANAGEMENT AND INSTITUTIONAL RESEARCH: CENTRALIZED VERSUS DECENTRALIZED PLANNING

Richard Howard, Director
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Charles H. Bryson, Research Associate
Office of Institutional Planning
Georgia State University

In recent years planning has become a very visable activity at most colleges and universities throughout the country. Although the aims of planning are the same - mapping a course of action addressing institutional goals and purposes - the individual process varies from institution to institution. In response to both internal and external organizational pressures, centralized planning has evolved at some institutions while a decentralized process has developed at others. To support planning in differently organized colleges and universities, data processing and institutional research have developed in manners consistant with institutional needs and processes.

In this paper, the planning at two universities is compared as it relates to data management and institutional research required to support two different planning styles. Specifically, the decentralized planning process at West Virginia University and the centralized planning process at Georgia State University are presented.

ISIS: IONA STUDENT INFORMATION SYSTEM

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The majority of today's college and university administrative data processing facilities aim at the development of information systems that are responsive to the users and the upper and middle levels of management. At the same time designers of data processing systems are interested in promoting operational efficiency, data integrity, security, and programming productivity. The adoption of a Data Base Management System (DBMS) provides a great number of benefits to all users, management as well as designers of data processing systems.

The selection of a DBMS is an intricate and difficult process, primarily because it poses a lot of questions to which valid answers must be obtained. For most facilities the need for a DBMS is a pressing and long overdue one.

The Iona Student Information System (ISIS) is a project that was undertaken in order to accomplish the following:

a) To gain knowledge of our data and data structures

b) To build our data bases

c) To recognize what we expect out of a DBMS

d) To develop our own DBMS

e) To write the applications for the Student Information System

The system has been designed to be (a) Data Element driven (b) modular (c) amenable to changes for enhancements.

The major components of the system are: (1) the Data Element Dictionary (2) the Code Tables (3) the user Screen Generator (4) the Generalized Inquiry/Update and (5) the Data Base Control.

The Data Element Dictionary and the Code Tables accurately describe the content and organization of the data base. The ISIS applications are driven by the current status of the Dictionary and Code Tables. In an on-line environment the user Screen Generator permits the users to generate their own screens by data element content and format design. These user screens may be used to supply or deposit actual data to and from the data base for the requested records. Chaining of several screens enables users to achieve flexibity in the on-line environment.

The Data Base Control provides an efficient and quick method for the Data Base manager and the programmers to set up permanent and temporary subfiles required to maintain proper functioning of the DBMS and the applications of ISIS.

An institution that decides to develop their own DBMS has the advantage of gaining good knowledge about their data and their present and future needs in processing their data. Both of these factors are essential for an efficient and functionally valuable information system.

A Cost Simulation Model for Information Systems in Post Secondary Education

by

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This paper describes briefly the simulation cost model that was developed and implemented for computing the consequences of laws and regulations relating to privacy of student data in institutions of post secondary education. Specifically included are the main provisions of the FERPA (Family Educational Rights), the Privacy Act of 1974 and its extensions recommended by the Commission appointed with the 1974 Privacy Act.

The parameters of the model are the coefficients of inspections, corrections, challenges, insertions of dissent negotiations, and reviews relative to privacy. Also as parameters are the levels of accuracy, and systems assurance, and the nature of data required for directory and research.

Systems variables include the levels of students and the institution, the state of the institutional data base, the extent of use of DBMS, the degree of centralization and availability of data, and finally, the policy formulation and training required for implementation.

There are 78 linear equations in the model. It requires 48 control variables such as what is the average clerical man hours required to receive and act on one data accuracy query (assuming reference reports available)? And 14 environmental variables (such as: What is the incremental cost of clerical work per hour)? This information was collected on a questionnaire form designed for the purpose of implementing this model.

The consequences calculated are the development costs (capital and personal) and running costs (personnel, storage, computer time and transmission costs).

The model itself is a set of linear equations adapted from Goldsteins model for the federal governmental implementation* of the 1974 Privacy Act.

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*The help, especially in the implementations of the model, of Giovannone, J. Lee and Martellaro is herewith gratefully acknowledged.

*R.C. Goldstein The Cost of Privacy Brighton Mo. Honeywell Information Systems. 1975 p. 150

The model is designed to be flexible enough to include some regulations enacted at a state level as inputs and calculate their cost implications.

The model is currently implemented in FORTRAN IV and is planned for implementation in interactive APL.

The model has been implemented on one campus of roughly 1200 students (head count). The costing for this institution for implementing privacy regulations are:

	Conversion Costs	Annual Costs
1) Notification of confidential recommendations	$ 0	$ 800
2) Release of Directory information	$ 200	$ 600
3) Record of Access to student records	$ 0	$ 3,100
4) Right to inspect and Review the educational records by the student	$ 0	$ 5,300
5) Right of students to challenge the content to insure accuracy	$ 0	$ 400
6) Insertion of written explanation into the record to insure accuracy	$ 0	$ 1,300
7) Claim dissemination - subject claim dessamation	$ 0	$ 1,300
8) HEW recommendations for protection of data system	$16,200	$ 0
9) Employee training	$ 2,000	$ 400
10) Systems Assurance - Audit	$11,600	$13,300
Totals	$30,700	$25,400

The model has yet to be tested for institutions of different sizes, levels and complexity (i.e., multi-campus institutions). The system is documented and available at reproduction cost to institutions interested in implementing and experimenting with the model.

SCHEDULING AND REGISTRATION
THE
CENTERPIECE OF A UNIVERSITY INFORMATION SYSTEM

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Three of four times a year there is a massive and sensitive task of matching student's course needs with the available resources. This matching is done through the process we identify as scheduling and registration. The outcomes of this activity reflect the quality of management decisions exercised as budgeted resources are put to the test. One can be sure that both strengths and weaknesses of the system will be exposed because these data are reflected in all cost studies and other utilization reports.

This paper describes the scheduling and registration activity at East Tennessee State University, and its relation to the integrated information system, sufficiently to address key factors in its design and the role of the user in its development. Also some successes and problems experienced in three years of operation and growth around this centerpiece will be discussed.

ERIC DATA ACCESS SYSTEM (EDAS)

by

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SUMMARY

The ERIC Data Access System (EDAS) is a joint project of the Eastern Illinois University Computer Center and the Library. The system was primarily developed in 1974 to meet the research and instructional needs of the Eastern Illinois University campus. Subsequently its products have been made available to nineteen other campuses.

The ERIC database, developed by the United States Office of Education, consists of over 300,000 abstracts and bibliographic data of research reports and journal articles. The database emphasizes the literature of practical applications which would be of considerable help to teachers and educational administrators as well as literature of significant recent research.

The EDAS was developed after analyzing the available commercial alternatives. Our analysis revealed that this data would be used very heavily; if we accessed it through a commercial online search system, it would probably be prohibitively expensive. Consequently we developed our own search system which operates in a batch mode. For the past three years the EDAS has processed about 1000 requests per year. It proved to be cost-effective and received a management improvement project award from the university's governing board for its cost-effectiveness.

The EDAS generates a variety of products which enable our faculty and students to utilize the ERIC document collection efficiently and effectively. The system was developed in a modular fashion so it can be implemented on other campuses in its totality or on an individual component basis.

APPLICATION OF DATA PROCESSING TO AN AUDIT OF STUDENT ENROLLMENT DATA

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The Kentucky Council on Higher Education authorized the first audit of student enrollment data in October, 1977. The utilization of data processing technology facilitated the development of procedures and format which would allow an examination of specific data elements concerning students. This paper describes the process used to gather, edit, and verify those data elements and the systems and procedures used by the institutions. Some statements will be made concerning future use of the procedure.

ADDITIONAL PHOTOGRAPHS FROM THE 1978 CAUSE NATIONAL CONFERENCE

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